

## 5. OVERVIEW OF THE PROPOSAL

### 5.1. Overview of the Study Area

The study area lies between the Northern/Western Provincial Border in the Vanrhyns Pass and Calvinia (Figure 2). The area lies on the Onder-Bokkeveld Plateau along the wide Oorlogskloof River Valley. The area consists largely of natural and open areas with some livestock farming and the towns of Nieuwoudtville and Calvinia. Approximately 70 kilometers of the R27 regional road was considered that included four bridges over the Oorlogskloof River. Seven existing borrow pits and six possible water sources for the construction activities were also considered that were situated a short distance north and south of the R27 road (Figure 3).

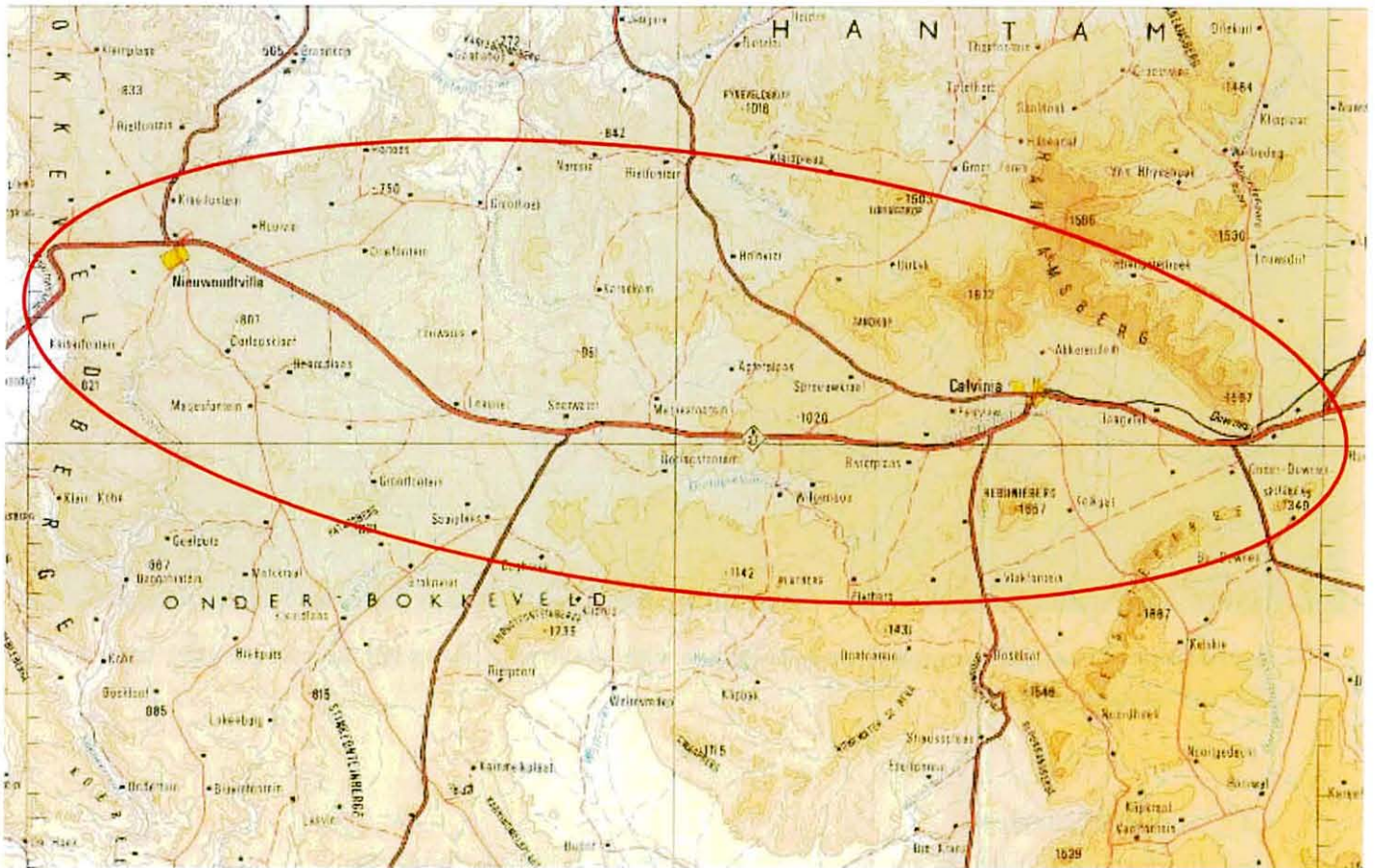


Figure 2. Locality 1 in 500 000 topographical map (3117 Calvinia) of the study area

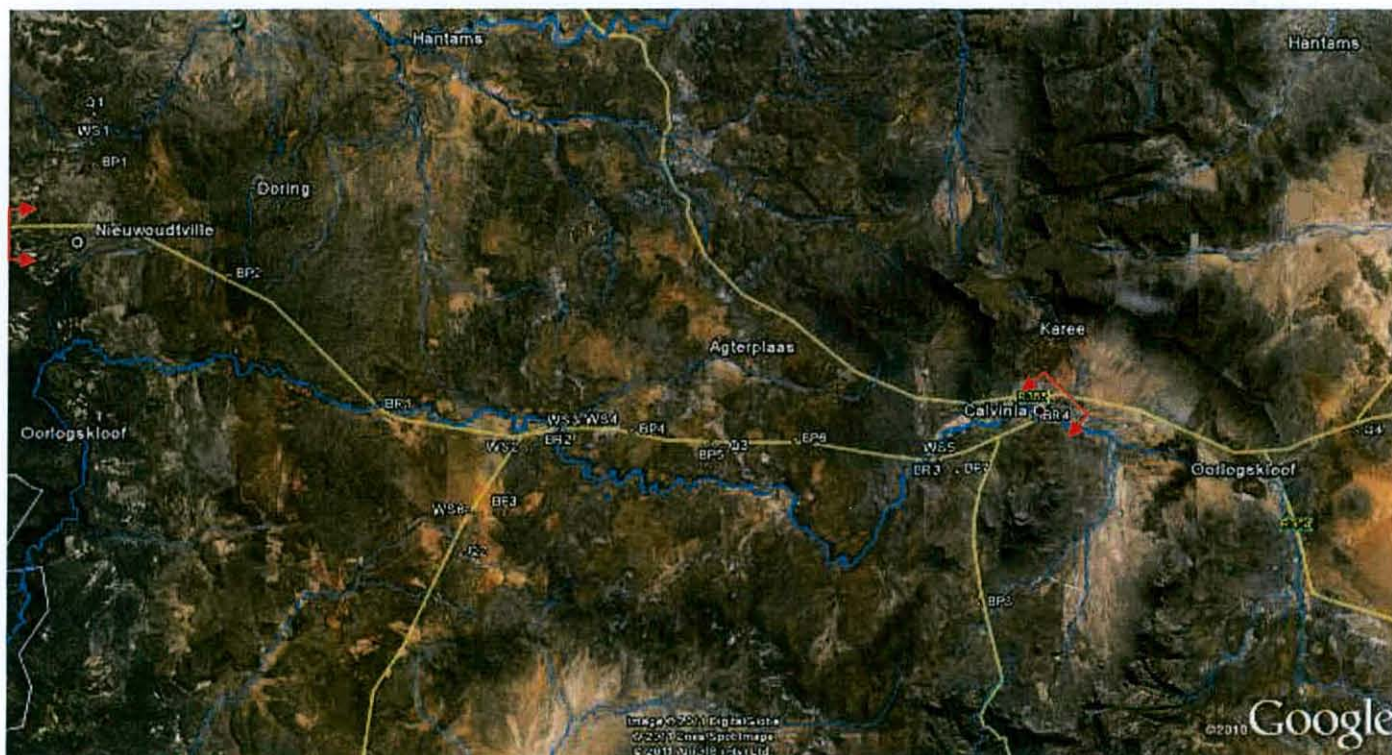
### 5.2. Activity Description

The strengthening and partial reconstruction of portions of the R27, Sections 7 and 8, between the Western/Northern Cape Provincial border (km 40.0) and Calvinia (km 70.0) will comprise of the following main components (Figure 3):

- Road works: The upgrading of the approximately 73-km road section by strengthening the existing layers and limited widening of the road;

- Bridges and culverts: The widening of three (of the four) bridges and the possible widening or reconstruction of some of the major culverts; and
- Borrow pits: The development of a number of borrow areas for the sourcing of road-building material and crushed aggregates. Seven potential borrow pits were identified for this assessment.

Six potential water sources were also identified to provide water for construction purposes.



**Figure 3.** Aerial image of the proposed road upgrade with locality of quarries (Q), borrow pits (BP), bridges (BR) and water sources (WS)

### 5.3. Legal Requirements

The following Acts, regulations and ordinances are applicable to the development:

- **The National Environmental Management Act (Act No. 107 of 1998)**

Chapter Seven of the NEMA states that:

“Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment”.

The Act also clearly states that the landowner, or the person using or controlling the land, is responsible for taking measures to control and rectify any degradation. These may include measures to:

- “(a) investigate, assess and evaluate the impact on the environment;*
- (b) inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment;*
- (c) cease, modify or control any act, activity or process causing the pollution or degradation;*
- (d) contain or prevent the movement of pollutants or degradation: or*
- (e) eliminate any source of pollution or degradation: or*
- (f) remedy the effects of the pollution or degradation.”*

- **NEMA Basic Assessment Regulations, GN R543 of 2010**

Activities listed in terms of Chapter 5 of NEMA in Government Notice No. R. 544, 5 and 6 trigger a mandatory Basic Assessment, or even a full scoping EIA process, prior to development.

The National Environmental Management Second Amendment Act (Act No.8 of 2004) provided for formal procedures for offenders in terms of Section 24G to apply for rectification of the unlawful commencement of listed activities.

- **National Water Act, 1998 (Act No. 36 of 1998)**

The purpose of the National Water Act is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorisation and register as users. The National Water Act also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

- **Regulations Requiring that a Water User be Registered, GN R.1352 (1999)**

Regulations requiring the registration of water users were promulgated by the Minister of the Department of Water Affairs (DWA) in terms of provision made in section 26(1)(c), read together with section 69 of the National Water Act, 1998. Section 26(1)(c) of the Act allows for registration of all water uses including existing lawful water use in terms of section 34(2). Section 29(1)(b)(vi) also states that in the case of a general authorisation, the responsible authority may attach a condition requiring the registration of such water use. The Regulations (Art. 3) oblige any water user as defined under section 21 of the Act to register such use with the responsible authority and effectively to apply for a Registration Certificate as contemplated under Art.7(1) of the Regulations.

- **General Authorisation in terms of s. 39 of the National Water Act, GN R 1199 of 2009**

Government Notice R1199 was issued as a revision of the General Authorisations (No. 1191 of 1999) for Section 21 (c) and (i) water uses as defined under the National Water Act (Act 36 of 1998). The revision was published and came into effect on 2009/12/18. According to the preamble to Part 6 of the National Water

Act, "This Part establishes a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing general authorisations in the Gazette..."

"The use of water under a general authorisation does not require a licence until the general authorisation is revoked, in which case licensing will be necessary..."

It is likely that the proposed activities will fall within the listed activities that can be Generally Authorised at the Western Cape Regional Office of the Department of Water Affairs, however an application for authorisation of the proposed activities will need to be submitted to them for confirmation that this is the case.

- **Conservation of Agricultural Resources Act (Act 43 of 1983)**

The objective of this Act is to provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants. The Act makes provision for the Minister to prescribe control measures, which need to be adhered to by landowners to whom they apply. These control measures can relate to activities such as the cultivation of virgin soil, the irrigation of land, the utilization and protection of vleis, marshes, water sponges, water courses and water sources, the regulating of the flow pattern of run-off water, and the utilization and protection of the vegetation. Control measures may contain prohibitions and obligations, but also make provision for exemptions to be granted and for different control measures to be applied to different forms of land use. A landowner who fails to comply with any control measure is guilty of an offence.

## **6. AQUATIC SYSTEMS IN THE STUDY AREA**

### **6.1. Description of the Study Site**

#### **a. Physical Characteristics**

The study area is largely located on the Nieuwoudtville/Onder-Bokkeveld Plateau between Calvinia and Nieuwoudtville. The area lies within the Olifants-Doring River catchment, with the Oorlogskloof River and its tributaries flowing parallel to the R27 road (Figure 4). The surround topography is relatively flat within the wide river valley of the Oorlogskloof, with the Hantams Mountains in the East and the escarpment on the Bokkeveld Mountains in the west. The surrounding farming activities occur along and within the river channels and have moderately modified the riverine habitat. In particular, large shallow farm dams have been constructed near Calvinia to impede winter surface water runoff.



**Figure 4.** A view of the wide Oorlogskloof River Valley near Calvinia with the Hantams Mountains in the background

### b. Climate

Calvinia has a Mediterranean climate and normally receives about 146mm of rain per year mostly during winter. The area has its lowest rainfall (1mm) in January and the highest (23mm) in June (Figure 5). The average midday temperatures for Calvinia range from 15.3°C in July to 30.6°C in January. The region is the coldest during July when the mercury drops to 1.4°C on average during the night.



**Figure 5.** Average monthly rainfall for the area (SA Explorer, 2008)

### c. Geology and Soil

The major geological features of the Onder-Bokkeveld plateau area and the adjoining Karoo are sandstone, shale, diamictite and an intrusive rock called dolerite. Table Mountain group sandstones occur primarily within the Vanrhyns Pass while the Bokkeveld Group shale and sandstones and the mixed, glacially-derived Dwyka Group diamictite occur to the east on the plateau. All of these relatively flat lying beds overlie much more ancient, folded and metamorphosed rocks of the Gariiep and Nama Groups, which formed between 600 and 500 million years ago by processes involving sedimentation and continental collision. These rocks are the grey phyllites and quartzites of the Knersvlakte and the red sandstones and shales which lie below the escarpment north of Nieuwoudtville and in the Koebee Valley.

The types of soils discernable from Figure 6 comprise largely of red, shallow soils on rock for much of the area (reddish areas in Figure 6), with soils with marked clay accumulation surrounding Calvinia and the central portion of the study area (orange and olive areas in Figure 6).

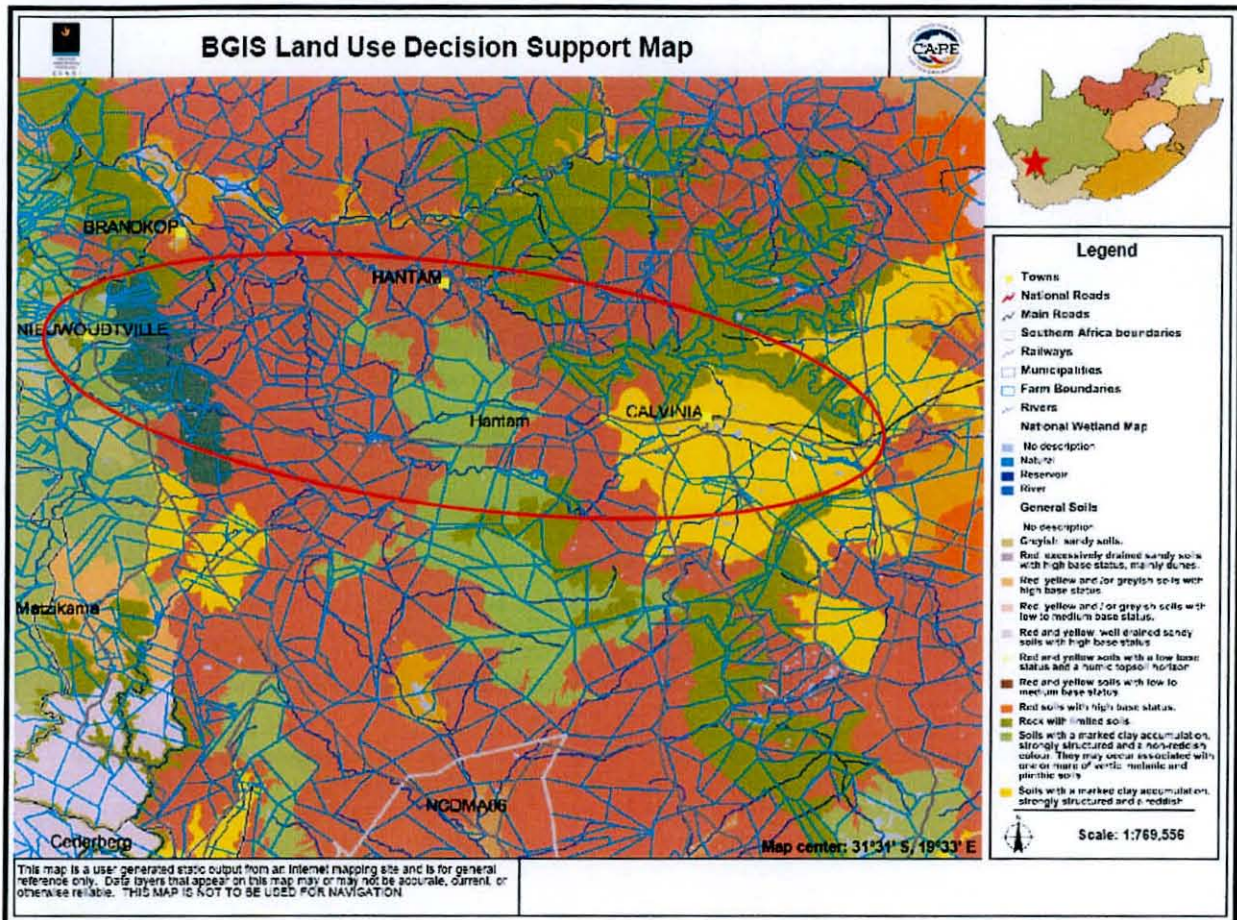


Figure 6. Soil map for the area (Biodiversity GIS, 2009)

#### d. Flora

The natural vegetation type that is dominant throughout the study is Hamtam Karoo vegetation type (least threatened), with Nieuwoudtville Shale Renosterveld (endangered) in the north-east and some Nieuwoudtville-Roggeveld Dolerite Renosterveld (least threatened) in the west (Figure 7). The vegetation is still largely natural in the higher lying and more remote areas, however closer to the towns and outside of the towns the vegetation has largely been modified by agricultural as well as urban activities.

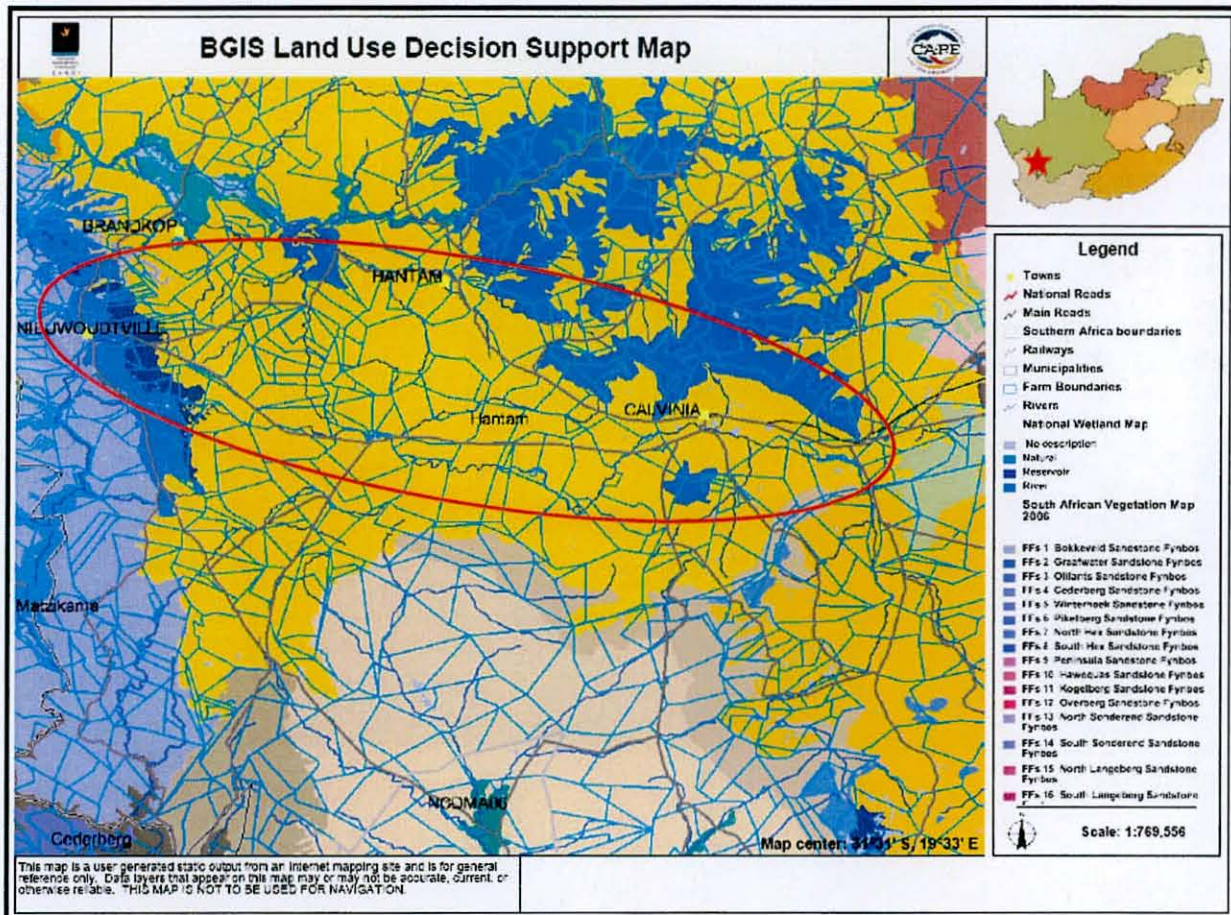


Figure 7. Vegetation map for the area (SANBI Biodiversity GIS)

#### e. Aquatic features and fauna

The main freshwater feature in the study area is the Oorlogskloof River (Figure 8). The river originates in the Roggeveldberge and flows westward past Calvinia and Nieuwoudtville. South of Nieuwoudtville it enters the Koebeeberge and flows through a deep riverine gorge where it is known as the Koebee River. It flows southwards to its confluence with the Doring River, a major tributary of the Olifants River which enters the Atlantic Ocean on the west coast of South Africa. The river is discussed in more detail in the following section. Another Doring River, which is a tributary of the Hantam River, flows north and westward within the Olifants/Doring River System is also included within the study area.



**Figure 8.** The Oorlogskloof River near Calvinia



**Figure 9.** The Doring River near Nieuwoudtville

**f. Land use**

The area surrounding Nieuwoudtville and Calvinia consists largely of natural areas (Figure 10). The urban areas of Nieuwoudtville and Calvinia occur at the western and eastern extents of the study area. These towns are surrounded by some cultivated agriculture, which is scattered mostly along the watercourses in the area and consists largely of grazing for sheep farming. The area is also an important area for eco-tourism, with Nieuwoudtville being well known for its bulbs which flower in the spring.



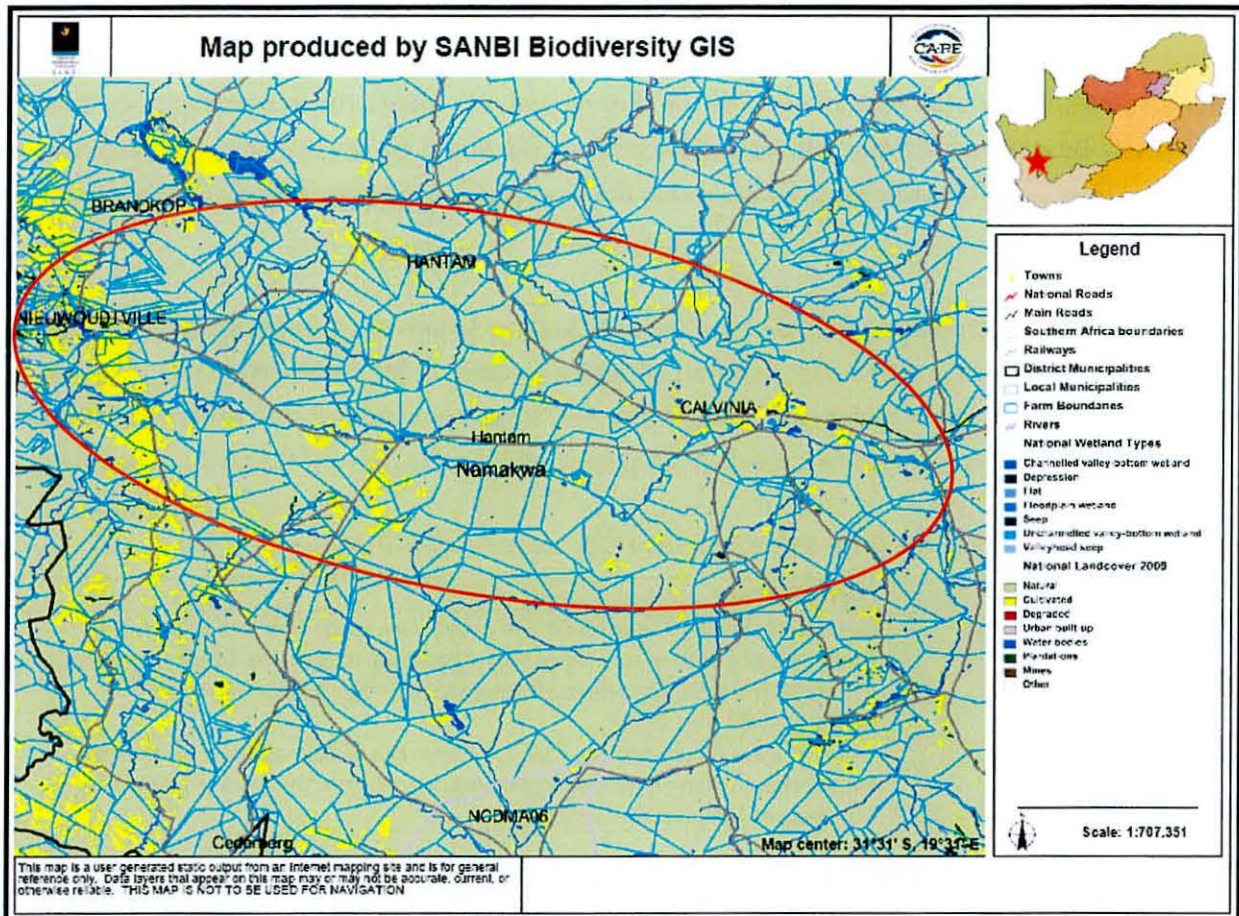


Figure 10. Land cover map for the area (SANBI Biodiversity GIS, 2011)

## 6.2. Freshwater Assessment of the Study Area

The Index for Habitat Integrity (IHI) and a Site Characterisation were used to provide information on the ecological condition of the Oorlogskloof and Doring Rivers.

### a. River classification

In order to assess the condition and ecological importance and sensitivity of the stream, it is necessary to understand how the stream might have appeared under unimpacted conditions. This is achieved through classifying rivers according to their ecological characteristics, in order that it can be compared to ecologically similar rivers.

River typing or classification involves the hierarchical grouping of rivers into ecologically similar units so that inter- and intra-river variation in factors that influence water chemistry, channel type, substratum composition and hydrology are best accounted for. Any comparative assessment of river condition should only be done between rivers that share similar physical and biological characteristics under natural conditions. Thus, the classification of rivers provides the basis for assessing river condition to allow comparison between similar river types. The primary classification of rivers is a division into Ecoregions. Rivers within an ecoregion are further divided into sub-regions.

**Ecoregions** are groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For the purposes of this study, the ecoregional classification presented in Department of Water Affairs and Forestry in 1999, which divides the country's rivers into 18 ecoregions, was used. The river assessed lies within the Great Karoo Ecoregion, with the characteristics as described in Table 1.

**Sub-regions** (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important. The use of geomorphological features is based on the assumption that these are a major factor in the determination of the distribution of the biota. Table 2 provides the geomorphological features of the streams assessed.

**Table 1.** Characteristics of the Great Karoo Ecoregion (Dominant Types In Bold)

| Main Attributes                    | Characteristics   |
|------------------------------------|---|
| Terrain Morphology: Broad division | <b>Plains; Low Relief;</b> Plains Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills, Lowlands; Mountains; Moderate to High Relief; <b>Closed Hills; Mountains; Moderate and High Relief;</b> Table-Lands: Moderate and High Relief |
| Vegetation types                   | Valley Thicket; <b>Central Nama Karoo;</b> Eastern Mixed Nama Karoo; <b>Great Nama Karoo;</b> Upper Nama Karoo; Lowland Succulent Karoo; Upland Succulent Karoo; Escarpment Mountain Renosterveld;  |
| Altitude (m a.m.s.l)               | 300-1700  |
| MAP (mm)                           | 0 to 500  |
| Rainfall seasonality               | Very late summer to winter  |
| Mean annual temp. (°C)             | 10 to 20  |

#### b. Site Characterisation

The Oorlogskloof and Doring rivers both have a bedrock-and-sand/silt substrate. As they drain Karoo and mountain fynbos vegetation, they are frequently turbid and are seasonal in nature. Vegetation within the streams is also of a wetland nature, filled with phragmites reeds, with *Juncus* sp. reeds and grasses. This vegetation is likely sustained for much of the year by sub-surface and groundwater contributions rather than surface water flows.

From the Site Characterisation assessment, the geomorphological and physical characteristics of the rivers can be classified as shown in Table 2.

**Table 2.** Geomorphological and Physical features of the Oorlogskloof River

|                              |   |
|------------------------------|---|
| <b>Geomorphological Zone</b> | Lower foothill river  |
| <b>Lateral mobility</b>      | Unconfined on the plateau but confined within kloof and hilly areas                       |
| <b>Channel form</b>          | Simple  |
| <b>Channel pattern</b>       | Single and multiple thread: low sinuosity   |
| <b>Channel type</b>          | Mixed (alluvium with bedrock)   |
| <b>Channel modification</b>  | Moderate modification (farming into riparian zone and some alien vegetation encroachment) |
| <b>Hydrological type</b>     | Seasonal to ephemeral   |
| <b>Ecoregion</b>             | Great Karoo   |
| <b>DWA catchment</b>         | E24K, E32E, E40A to C   |
| <b>Vegetation type</b>       | Hantam Karoo with Nieuwoudtville Shale and Dolerite Renosterveld                          |
| <b>Rainfall region</b>       | Winter  |

### c. Index of Habitat Integrity

The evaluation of Index of Habitat Integrity (IHI) provides a measure of the degree to which a river has been modified from its natural state. This assessment was undertaken for the Oorlogskloof and upper Doring rivers (Tables 3 and 4). The methodology (DWA, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of degradation of a river. The severity of each impact is ranked using a six-point scale with 0 (no impact), 1 to 5 (small impact), 6 to 10 (moderate impact), 11 to 15 (large impact), 16 to 20 (serious impact) and 21 to 25 (critical impact).

The IHI assessment is based on an evaluation of the impacts of two components of the rivers, the riparian zone and the instream habitat. Assessments are made separately for both components, but data for the riparian zone are interpreted primarily in terms of the potential impact on the instream component.

The estimated impact of each criterion is calculated as follows:

$$\text{Rating for the criterion}/\text{maximum value (25)} \times \text{weight (percent)}$$

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components respectively. The total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category.

#### **Oorlogskloof River:**

The Oorlogskloof River downstream of Calvinia (Figure 11) was assessed during the site visit. The results from the habitat integrity assessment are shown in Table 3.

**Table 3.** Index of Habitat Integrity Assessment results and criteria assessed in the Oorlogskloof River downstream of Calvinia

| Instream Criteria    | Weight | Score    | Riparian Zone Criteria         | Weight | Score    |
|----------------------|--------|----------|--------------------------------|--------|----------|
| Water abstraction    | 14     | 8        | Water abstraction              | 13     | 8        |
| Flow modification    | 13     | 12       | Inundation                     | 11     | 3        |
| Bed modification     | 13     | 7        | Flow modification              | 12     | 11       |
| Channel modification | 13     | 5        | Water quality                  | 13     | 7        |
| Water quality        | 14     | 7        | Indigenous vegetation removal  | 13     | 10       |
| Inundation           | 10     | 3        | Exotic vegetation encroachment | 12     | 9        |
| Exotic macrophytes   | 9      | 3        | Bank erosion                   | 14     | 11       |
| Exotic fauna         | 8      | 4        | Channel modification           | 12     | 5        |
| Solid waste disposal | 6      | 4        |                                |        |          |
| <b>Category</b>      |        | <b>C</b> | <b>Category</b>                |        | <b>D</b> |

The Oorlogskloof River downstream of Calvinia is in a moderately modified state with the major impacts being some flow modification, farming within the riparian zone (removal of riparian vegetation and tramping of livestock within the river channel) and a low density of invasive alien vegetation growth (*Prosopis* sp.).



**Figure 11.** View of the Oorlogskloof River downstream of Calvinia

**Doring River:**

The Doring River near Nieuwoudtville (Figure 12) has a largely natural habitat with minimal habitat disturbance activities. The results from the habitat integrity assessment are shown in Table 4.

**Table 4.** Index of Habitat Integrity Assessment results and criteria assessed in the Doring River near Nieuwoudtville

| <b>Instream Criteria</b> | <b>Weight</b> | <b>Score</b> | <b>Riparian Zone Criteria</b>  | <b>Weight</b> | <b>Score</b> |
|--------------------------|---------------|--------------|--------------------------------|---------------|--------------|
| Water abstraction        | 14            | 5            | Water abstraction              | 13            | 5            |
| Flow modification        | 13            | 3            | Inundation                     | 11            | 4            |
| Bed modification         | 13            | 8            | Flow modification              | 12            | 3            |
| Channel modification     | 13            | 6            | Water quality                  | 13            | 3            |
| Water quality            | 14            | 3            | Indigenous vegetation removal  | 13            | 7            |
| Inundation               | 10            | 4            | Exotic vegetation encroachment | 12            | 4            |
| Exotic macrophytes       | 9             | 2            | Bank erosion                   | 14            | 8            |
| Exotic fauna             | 8             | 2            | Channel modification           | 12            | 6            |
| Solid waste disposal     | 6             | 4            |                                |               |              |
| <b>Category</b>          |               | <b>B</b>     | <b>Category</b>                |               | <b>B</b>     |



**Figure 12.** The Doring River downstream of the R357 road bridge

#### **d. Ecological Importance and Sensitivity (EIS)**

EIS (Table 5) considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table 6). The median of the resultant score is calculated to derive the EIS category (Table 7).

**Table 5.** Ecological importance and sensitivity categories (DWAF, 1999)

| EISC             | General description  | Range of median |
|------------------|--|-----------------|
| Very high        | Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use. | >3-4            |
| High             | Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.                   | >2-≤3           |
| Moderate         | Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.              | >1-≤2           |
| Low/<br>marginal | Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.   | ≤1              |

**Table 6.** Definition of the four-point scale used to assess biotic and habitat determinants presumed to indicate either importance or sensitivity

| Four point scale | Definition  |
|------------------|---|
| 1                | One species/taxon judged as rare or endangered at a local scale.                                    |
| 2                | More than one species/taxon judged to be rare or endangered on a local scale.                       |
| 3                | One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.           |
| 4                | One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books) |

**Table 7.** Results of the EIS assessment for the Oorlogskloof and Doring rivers





| Biotic Determinants  | Oorlogskloof River | Doring River        |
|--|--------------------|---------------------|
| Rare and endangered biota  | 2                  | 2                   |
| Unique biota   | 2                  | 2                   |
| Intolerant biota   | 1                  | 1                   |
| Species/taxon richness   | 2                  | 2                   |
| Aquatic Habitat Determinants   |                    |                     |
| Diversity of aquatic habitat types or features   | 1                  | 2                   |
| Refuge value of habitat type   | 1                  | 2                   |
| Sensitivity of habitat to flow changes   | 2                  | 2                   |
| Sensitivity of flow related water quality changes  | 1                  | 2                   |
| Migration route/corridor for instream and riparian biota                                       | 2                  | 2                   |
| National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs | 2                  | 2                   |
| <b>RATINGS</b>   | <b>1.6</b>         | <b>1.9</b>          |
| <b>EIS CATEGORY</b>  | <b>low</b>         | <b>Moderate/low</b> |





The Oorlogskloof River is considered to be of a low Ecological Importance and Sensitivity, while the Doring River is considered to be of a moderate to low sensitivity.

### 6.3 Assessment of Sites




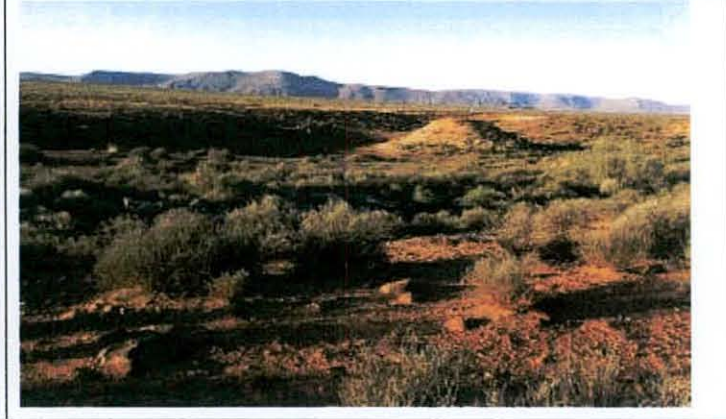
The proposed borrow pit sites, quarries, bridges and water sources that were assessed are discussed in the following tables:

**Table 8.** Assessment of Borrow Pit Sites

| Borrow Pit Site No.           | Google Earth image   | Photo   | Comment   |
|-------------------------------|--|---|---|
| 1. R27-7<br>km 51 LHS<br>6.9  |   |   | <p>Kliprivier Farm borrow pit is sited at the top of a small hill, adjacent to an existing borrow pit. There are no expected aquatic ecosystem issues.</p>  |
| 2. R27-8<br>km 9.5 LHS<br>0.2 |  |  | <p>Buffelsvlei Farm borrow pit sited adjacent to a small drainage line. The vegetation around the pit is in good condition and 3 porcupines were sighted in the pit. Aardvark hole inhabited by the porcupines were also found on the south-west bank of the pit. The pit is not linked to the drainage channel and the proposed expansion of the pit is to the north-east, away from the drainage therefore no aquatic ecosystem issues are foreseen at this site. However it is recommended that if this pit is utilized, access to the pit does not disturb the drainage channel and that the pit is meaningfully rehabilitated in terms of its future storage of water.</p> |

|   |  |   |   |
|---|--|---|---|
| <p>3. R27-8<br/>Km 32.6<br/>RHS 6.2</p> |   |   | <p>Iceland Spar Mine Site: The borrow pit is sited at the top of a small hill, at an existing mine with numerous stockpiles. Only the stockpiles will be removed. While there is some drainage down the hill side, there are no expected aquatic ecosystem issues.</p>  |
| <p>4. R27-8<br/>km 39.8<br/>LHS 0.1</p> |  |  | <p>Matjiesfontein Farm: this borrow pit is currently being utilized for the storage of water. With flow from the adjacent drainage channels being diverted into the pit. Should this pit be extended as proposed (white polygon in Google image), the site should be rehabilitated to allow for more efficient use of the water and the landowner should contact DWA regarding authorization for the storage of water in the pit.</p> |



|   |  |   |  |
|---|--|---|--|
| <p>5. R27-8<br/>km 45.0<br/>RHS 0.2</p> |   |   | <p>Doega Farm: The site is on previously disturbed ground with no visible drainage or aquatic features. No freshwater issues are expected.</p> |
| <p>6. R27-8<br/>km 50.4<br/>LHS 0.1</p> |  |  | <p>The site is on previously disturbed ground with no visible drainage or aquatic features. No freshwater issues are expected.</p>             |








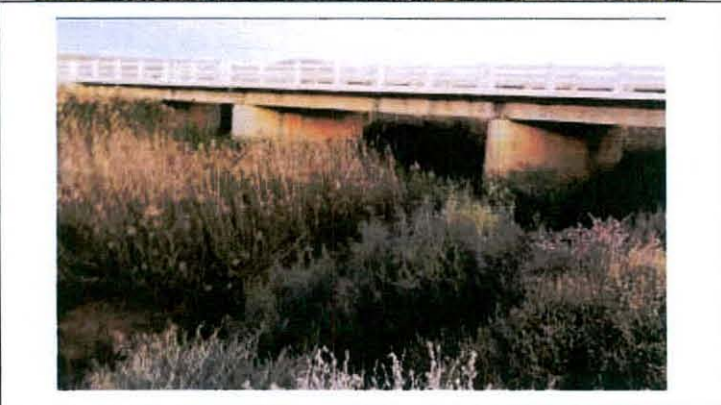
|  |  |   |   |
|--|--|---|---|
| <p>7. R27-8<br/>km61.6<br/>RHS</p>       |   |   | <p>The site is on previously disturbed ground with no visible drainage or aquatic features. No freshwater issues are expected.</p>                              |
| <p>8. R27-8<br/>km 64.2<br/>RHS 11.0</p> |  |  | <p>Vlakkefontein Farm: The borrow pit is an existing borrow pit with no visible drainage or water features. There are no expected aquatic ecosystem issues.</p> |

Table 9. Assessment of Bridge Sites

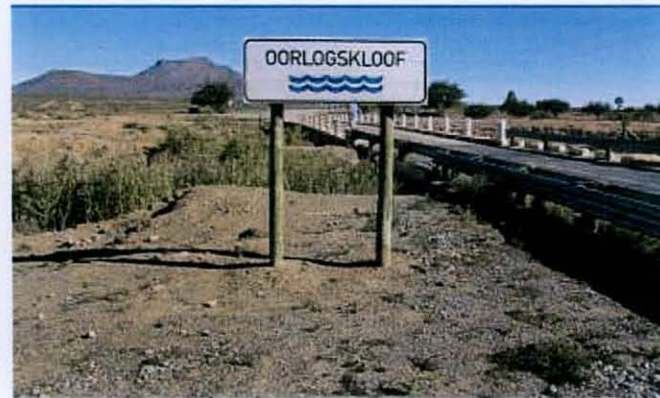
| Bridge Site Number   | Google Earth image   | Photo   | Comment   |
|----------------------|--|---|---|
| 1. R27-8<br>km 22.69 |   |   | <p>Oorlogskloof River Bridge (47.8 m by 10.4m with 4 piers). No major structural works planned. River dominated by phragmites, with some Juncus sp, weedy shrubs and Prosopis sp. The bed was largely dry and consisted of an alluvial substrate with bedrock. The southern bank is highly eroded. No freshwater issues are expected at the bridge, with the recommendations provided in the following section.</p> |
| 2. R27-8<br>km 34.92 |  |  | <p>Soetwater River Bridge - (30.1 m by 7.86m with 2 piers). Bridge to be widened on both sides by 1.27m.</p>  |

3. R27-8  
km 59.2







Oorlogskloof River Bridge - (48.2 m by 8m with 4 piers). Bridge to be widened on both sides by 1.20m.







4. R27-8  
km 67.1



Oorlogskloof River Bridge - (84.5 m by 7.1m with 4 piers). Bridge to be widened on one side only.

Table 10. Assessment of Water Abstraction Sites

| Water Abstraction Site Number | Google Earth image   | Photo  | Comment   |
|-------------------------------|--|--|---|
| 1. R27-7 km<br>51 LHS 7.1     |   |    | <p>Doring River, Kliprivier Farm: The river channel at the R27 bridge is dominated by <i>Phragmites</i> reeds, with some <i>Juncus</i> sp and grass sp. downstream The bed was dry and consisted of an alluvial substrate with bedrock. This proposed water source is 350m upstream of the Nieuwoudtville waterfall, an important tourism feature for the area. The river also consists largely of river valley bottom wetland habitat and has been identified as a Freshwater Ecosystem Protected Area. It is therefore advised that an alternative water source be utilized for this area. The river flow is also of a seasonal nature and would not be a reliable water source as construction activities may need to take place during the dry season. Authorization will need to be given from DWA for the intended water abstraction.</p> |
| 2. R27-8 km<br>32.6 RHS 1.5   |  |  | <p>Soetwater Farm: Water is to be taken from an existing water pump. If the water to be abstracted is within the existing authorization for Soetwater Farm then no additional authorization from DWA is required.</p>   |

|  |  |  |   |
|--|--|--|---|
| <p>3 R27-8 km<br/>35 RHS 0.15</p>        |   |    | <p>Toekoms Farm: Water is to be taken from an existing water pump. If the water to be abstracted is within the existing authorization for Soetwater Farm then no additional authorization from DWA is required.</p>   |
| <p>4 R27-8 km<br/>36.0 LHS 0.5</p>       |   |    | <p>Soetwater Farm: Water is to be taken from an existing water pump. If the water to be abstracted is within the existing authorization for Soetwater Farm then no additional authorization from DWA is required.</p> |
| <p>5. R27-8 km<br/>60.0 RHS<br/>0.02</p> |  |  | <p>Rivier Farm: Water is to be taken from an existing water pump. If the water to be abstracted is within the existing authorization for Soetwater Farm then no additional authorization from DWA is required.</p>    |

6 R27-8 km  
32.6 RHS 6.2



Bloedzuigerfontein farm: Water is to be taken from an existing water pump. If the water to be abstracted is within the existing authorization for Soetwater Farm then no additional authorization from DWA is required.

## 7. ASSESSMENT OF IMPACTS

### a. Description and assessment of Impacts of proposed activities

This section provides an assessment of the potential impacts to freshwater ecosystems that are likely to be associated with the proposed development activities. The impact assessment and recommended mitigation measures are grouped according to the various proposed activities, that is the proposed upgrade of the road and the bridges; the use of the borrow pits; and the abstraction of water for construction purposes.

The roadway and bridges are already in existence adjacent to the river channel and within the riverbed, respectively, and together with a number of other physical modifications to the river bed and channel of the upper and lower reach of the river (as described in the previous section), have resulted in a moderately to largely modified aquatic ecological condition in the river within the reach to be impacted on by the proposed activities. Therefore the likely impacts of the proposed upgrade of the road and bridges are expected to be mostly of limited intensity and of a short term, during the construction phase. Longer term impacts that are likely to occur as a result of the proposed activity are the encroachment of invasive alien vegetation into the riparian zone, where the banks have been disturbed by the construction activities. The water used for construction purposes is also mostly already allocated water, with only the proposed abstraction from the Doring River near Nieuwoudville being of concern.

With regards to the borrow pits, these are also existing disturbances and for many of the proposed sites, the opportunity actually exists for some rehabilitation of the sites once the stockpiles have been removed.

#### **Impact of proposed upgrade of the road and bridges:**

- **Nature of Impact:** A limited impact on the riparian habitat of the Oorlogskloof River and its tributaries that are crossed by the R27 road (Table 9) is expected during the construction phase due to the activities associated with road and bridge upgrades.

**Significance of impacts without mitigation:** A localized impact of low intensity that is expected to have a low to negligible overall significance in terms of its impact on the identified aquatic ecosystems in the area. The existing riparian habitat has already been disturbed by surrounding farming activities, with much of the vegetation associated with the river being limited to within the river channel. The disturbance of riparian habitat during and after the construction activities provides an opportunity for invasive alien plants to proliferate in these areas that are already in a disturbed condition.

**Proposed mitigation:** It is important that the existing riparian zones that provide this buffering function for the river are rehabilitated after construction is completed by revegetating the areas disturbed by the construction activities with suitable indigenous riparian plants, such as mentioned *Acacia Karoo*. Invasive alien plants that currently exist within the immediate area of the construction activities should also be removed and the sites should be monitored post-construction



for a period of three years to ensure that these disturbed areas do not become reinfested with invasive alien plants.

Significance of impacts after mitigation: The opportunity exists for the current state of the riparian zones adjacent to the roadway to be improved. A localized, short-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be very low.

- Nature of Impact: A temporary impedance of the flow in the Oorlogskloof River at the river crossing sites may occur as a result of construction activities within the river channel.

Significance of impacts without mitigation: The construction activities would be expected to have a very limited impact on the flow in the stream in terms of the extent and duration.

Proposed mitigation: Activities within the river channel during the construction phase should be limited as far as possible in terms of their spatial and temporal extent. Construction should preferably take place before the onset of the winter rainfall to ensure minimal impact on flow. In the longer term, the upgraded bridge structures should not impede the flow and in particular the low flow in the river. All rubble and waste material associated with the bridge structures upgrade that is within the channel should be removed after construction is complete.

Significance of impacts after mitigation: A localised impact of low intensity that is expected to have a low overall significance in terms of its impact on the identified aquatic ecosystems in the area during construction phase only. An impact of negligible significance is expected post-construction.

- Nature of impact: Water quality impairment and an increase in turbidity - Impairment of the surface water quality could potentially occur, namely sedimentation during the construction phase.

Significance of impacts without mitigation: A localized impact of low intensity that is expected to have a low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Runoff from the construction site(s) should be prevented from entering the river and should rather be diverted through screens and off-channel retention ponds. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located away from the river system and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase.

Significance of impacts after mitigation: Provided that the mitigation measures are effectively implemented the water quality impacts of the development should be of low to negligible significance.

**Impact of the extraction of road construction materials from the proposed borrow pits:**

- **Nature of Impact:** An impact of very limited significance is expected on the drainage characteristics of minor tributaries of the Oorlogskloof River associated with some of the proposed borrow pits during and after the construction phase, namely: Borrow Pits 2 and 4 (Table 8). This is due to the fact that the borrow pits are already in existence and most of the sites with drainage concerns can be rehabilitated.

**Significance of impacts without mitigation:** The above-mentioned borrow pits occur in close proximity to minor tributaries and drainage channels of the Oorlogskloof and Doring Rivers. As a result of past activities the habitat and flow in these channels have been impacted on. These habitat and flow modifications can however be mitigated once removal of materials from these sites has been completed.

**Proposed mitigation:** All stockpiled material from the borrow pits should be removed from the drainage channels or stream beds and the channel rehabilitated with the removal of invasive alien plants. Where access to the borrow pit is through the drainage channel, disturbance of the channel should be limited.

**Significance of impacts after mitigation:** The opportunity exists for the current state of the riparian zones adjacent to the borrow pits and quarries to be improved. A localized, short-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a low positive impact.

**Impact of the abstraction of water for the road construction purposes at the proposed sites:**

- **Nature of impact:** A moderate significance impact for the proposed water abstraction could be expected for the site in the Doring River only. All the other sites are expected to have a negligible impact due to the fact that the water abstraction is via an existing groundwater allocation.

**Significance of impact without mitigation:** Moderate to high due to the sensitivity of the downstream ecosystem

**Proposed mitigation:** It is recommended that an alternative water source be sought.

**Cumulative impact of the overall project activities on freshwater ecosystems:**

The area to be impacted by the proposed activity is already moderately modified as a result of previous road construction activities as well as modification of the river banks and drainage channels by adjacent farming activities and the impacts from the two towns, Calvinia and Nieuwoudtville. These activities have all contributed to a modification of both the instream and riparian aquatic habitats and the introduction of invasive alien plants into the riparian zone. Considering that the proposed activities are to the existing road, one can expect that the cumulative impact of this activity on the river system will be of a low significance.

b. Summary of assessment of potential impacts of the proposed activities:

**Construction Phase:**

| Potential impact on freshwater features | Proposed upgrade of R27 and bridges  |
|---|--|
| Nature of impact:                       | Limited <b>disturbance of freshwater related habitats</b> at the construction sites and possibly for a short distance downstream of the structures   |
| Extent and duration of impact:          | Localised short term impacts   |
| Intensity of Impact                     | Low  |
| Probability of occurrence:              | Probable as a result of construction activities within stream bed and riparian zones   |
| Degree to which impact can be reversed: | Medium to high   |
| Irreplaceability of resources:          | Medium   |
| Cumulative impact prior to mitigation:  | Very low due to the existing degraded state of the river   |
| Significance of impact pre-mitigation   | Very low   |
| Degree of mitigation possible:          | Very low   |
| Proposed mitigation:                    | <ul style="list-style-type: none"> <li>➤ There should be minimal use of machinery within the river channel and riparian areas and disturbance within this area should be kept to a minimum.</li> <li>➤ The rehabilitation and re-vegetation of disturbed areas must take place post construction. Only appropriate indigenous riparian vegetation may be used for re-vegetation of disturbed areas.</li> </ul> |
| Cumulative impact post mitigation:      | Very Low   |
| Significance after mitigation           | Very Low   |

| Potential impact on freshwater features | Proposed upgrade of R27 and bridges  |
|---|--|
| Nature of impact:                       | A temporary <b>impedance of flow</b> during construction activities  |
| Extent and duration of impact:          | Localised short term impacts   |
| Intensity of Impact                     | Low  |
| Probability of occurrence:              | Probable depending on the extent of construction activities within stream bed  |
| Degree to which impact can be reversed: | High   |
| Irreplaceability of resources:          | Low  |
| Cumulative impact prior to mitigation:  | Low  |
| Significance of impact pre-mitigation   | Very low   |
| Degree of mitigation possible:          | Very low   |
| Proposed mitigation:                    | <ul style="list-style-type: none"> <li>➤ Minimise duration and extent of construction activities in the river – construction should also take place in the low flow season.</li> <li>➤ Clearing of debris and hard rubble associated with the construction activities should be undertaken post construction.</li> </ul> |
| Cumulative impact post mitigation:      | Very Low to negligible impact  |
| Significance after mitigation           | Very Low   |

| Potential impact on freshwater features | Proposed upgrade of R27 and bridges   |
|---|---|
| Nature of impact:                       | Downstream <b>water quality impacts</b> as a result of runoff from construction activities  |
| Extent and duration of impact:          | Localised short term impacts  |
| Intensity of Impact                     | Low   |
| Probability of occurrence:              | Probable  |
| Degree to which impact can be reversed: | High  |
| Irreplaceability of resources:          | Low   |
| Cumulative impact prior to mitigation:  | Low   |
| Significance of impact pre-mitigation   | Low   |
| Degree of mitigation possible:          | Very low  |
| Proposed mitigation:                    | <ul style="list-style-type: none"> <li>➤ Runoff from the construction site should be prevented from entering the river but should rather be diverted through screens and off-channel retention ponds. (see previous comments)</li> <li>➤ All materials on the construction site should be properly stored and contained.</li> <li>➤ Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located away from the river system and regularly serviced.</li> <li>➤ These measures should be addressed, implemented and monitored in term of the EMP for the construction phase.</li> </ul> |
| Cumulative impact post mitigation:      | Very Low  |
| Significance after mitigation           | Very Low  |

| Potential impact on freshwater features | Proposed abstraction of water for construction purposes in the upgrade of R27             |
|---|---|
| Nature of impact:                       | A short term <b>reduction of flow</b> during construction activities                      |
| Extent and duration of impact:          | Localised short term impacts  |
| Intensity of Impact                     | High  |
| Probability of occurrence:              | Probable depending on flow in river   |
| Degree to which impact can be reversed: | Medium  |
| Irreplaceability of resources:          | Fully reversible  |
| Cumulative impact prior to mitigation:  | Low   |
| Significance of impact pre-mitigation   | Low   |
| Degree of mitigation possible:          | None  |
| Proposed mitigation:                    | <ul style="list-style-type: none"> <li>➤ Identify an alternative water source.</li> </ul> |
| Cumulative impact post mitigation:      | Low   |
| Significance after mitigation           | Low   |

Operation Phase:

|   |   |
|---|---|
| Potential impact on freshwater features | Proposed upgrade of R27 and bridges   |
| Nature of impact:                       | Limited <b><i>disturbance of freshwater related habitats</i></b> at the bridges and along the length of the road where construction activities have taken place |
| Extent and duration of impact:          | Localised longer term impacts   |
| Intensity of Impact                     | Low   |
| Probability of occurrence:              | Probable as a result of construction activities within stream bed and riparian zones  |
| Degree to which impact can be reversed: | Medium to high  |
| Irreplaceability of resources:          | Low   |
| Cumulative impact prior to mitigation:  | Very low due to the existing degraded state of these streams, as well as the impacts of the flooding that took place  |
| Significance of impact pre-mitigation   | Very low  |
| Degree of mitigation possible:          | Very low  |
| Proposed mitigation:                    | ➤ Disturbed areas should be monitored and kept free of invasive alien plant growth.   |
| Cumulative impact post mitigation:      | Very Low  |
| Significance after mitigation           | Very Low  |

|   |   |
|---|---|
| Potential impact on freshwater features | Proposed removal of road building material from borrow pit sites 2 and 4  |
| Nature of impact:                       | Limited <b><i>disturbance of freshwater related habitats</i></b> at the above-mentioned borrow pits   |
| Extent and duration of impact:          | Localised longer term impacts   |
| Intensity of Impact                     | Low   |
| Probability of occurrence:              | Probable as a result of material removal activities within stream bed and riparian zones  |
| Degree to which impact can be reversed: | High  |
| Irreplaceability of resources:          | Medium  |
| Cumulative impact prior to mitigation:  | Very low due to the existing degraded state of the river  |
| Significance of impact pre-mitigation   | Low   |
| Degree of mitigation possible:          | Moderate  |
| Proposed mitigation:                    | <ul style="list-style-type: none"> <li>➤ Stockpiled material must be removed from the drainage/stream channel.</li> <li>➤ The rehabilitation and re-vegetation of disturbed areas must take place post construction. Only appropriate indigenous riparian vegetation may be used for re-vegetation of disturbed areas.</li> </ul> |
| Cumulative impact post mitigation:      | Very Low  |
| Significance after mitigation           | Very Low  |

## 8. CONCLUSIONS AND RECOMMENDATIONS

The Oorlogskloof River is in a moderately modified ecological state, with low ecological importance and sensitivity. The expected impacts of the proposed activities are likely to be of a very low significance and limited to the already disturbed area surrounding the existing road and bridges, as well as the borrow pits. They are also likely to mostly occur while construction activities are taking place. Provided that the following recommended mitigation measures are implemented the significance of the impact is expected negligible:

- Construction activities taking place within the river channel and riparian zone should be limited as far as possible to ensure minimum disturbance of this area. Disturbed areas within the riparian zones should be rehabilitated as soon as possible after construction has been completed and revegetated with suitable indigenous riparian vegetation.
- Construction should preferably take place during the low flow period.
- All rubble and waste material resulting from the construction activities should be removed from the river and drainage channels.
- Invasive alien plants should be removed from the riparian zone of the disturbed areas.
- Runoff from the construction sites should be prevented from entering the stream but should rather be diverted through screens and off-channel retention ponds.
- All materials on the construction sites should be properly stored and contained.
- Disposal of waste from the sites should also be properly managed.
- Construction workers should be given ablution facilities at the construction sites that are located away from the river system and regularly serviced.
- Stockpiled material at the borrow pits must be removed from the drainage/stream channel and the sites rehabilitated after material has been removed.

The only proposed activity of concern is the proposed abstraction of water from the Doring River for Construction purposes. Due to the conservation and tourism value of the Doring River downstream of the proposed abstraction site, it is recommended that an alternative water source be found. A water use authorization application will need to be submitted to the Department of Water Affairs Western Cape Regional Office for approval of the water use aspects of the proposed activities, and in particular the proposed construction activities associated with the upgrade of the bridges.

## 9. REFERENCES

Department of Water Affairs and Forestry. (1999). *Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1.0*. Resource Directed Measures for Protection of Water Resources, Pretoria, South Africa.

Department of Water Affairs and Forestry. (2005). *River Ecoclassification: Manual for Ecostatus Determination (Version 1)*. Water Research Commission Report Number KV 168/05. Pretoria.

**ANNEXURE A**

**DETAILS OF SPECIALIST AND DECLARATION OF INTEREST**

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## APPENDIX 1: DECLARATION OF INDEPENDENCE BY THE INDEPENDENT PERSON WHO COMPILED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS

I Antonia Belcher, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.

**Note:** The terms of reference must be attached.



Signature of the specialist:

15 May 2011

Date:

---

**APPENDIX 2: ATTACHED CURRICULUM VITAE:**

Full Name                    Antonia Belcher

Profession                   Aquatic Ecologist and Environmental Management (P. Sci. Nat. 400040/10)

Contact details            60 Dummer Street, Somerset West, 7139; Telephone: 082 883 8055

**Relevant work experience:**

Due to my involvement in the development and implementation of the River Health Program in the Western Cape, I have been a key part of the team that has undertaken six catchment or area wide 'state-of-river' assessments as well as routine monitoring and specialised assessments of rivers and wetlands in all the major catchments for the Western Cape.

**Relevant work experience follows:**

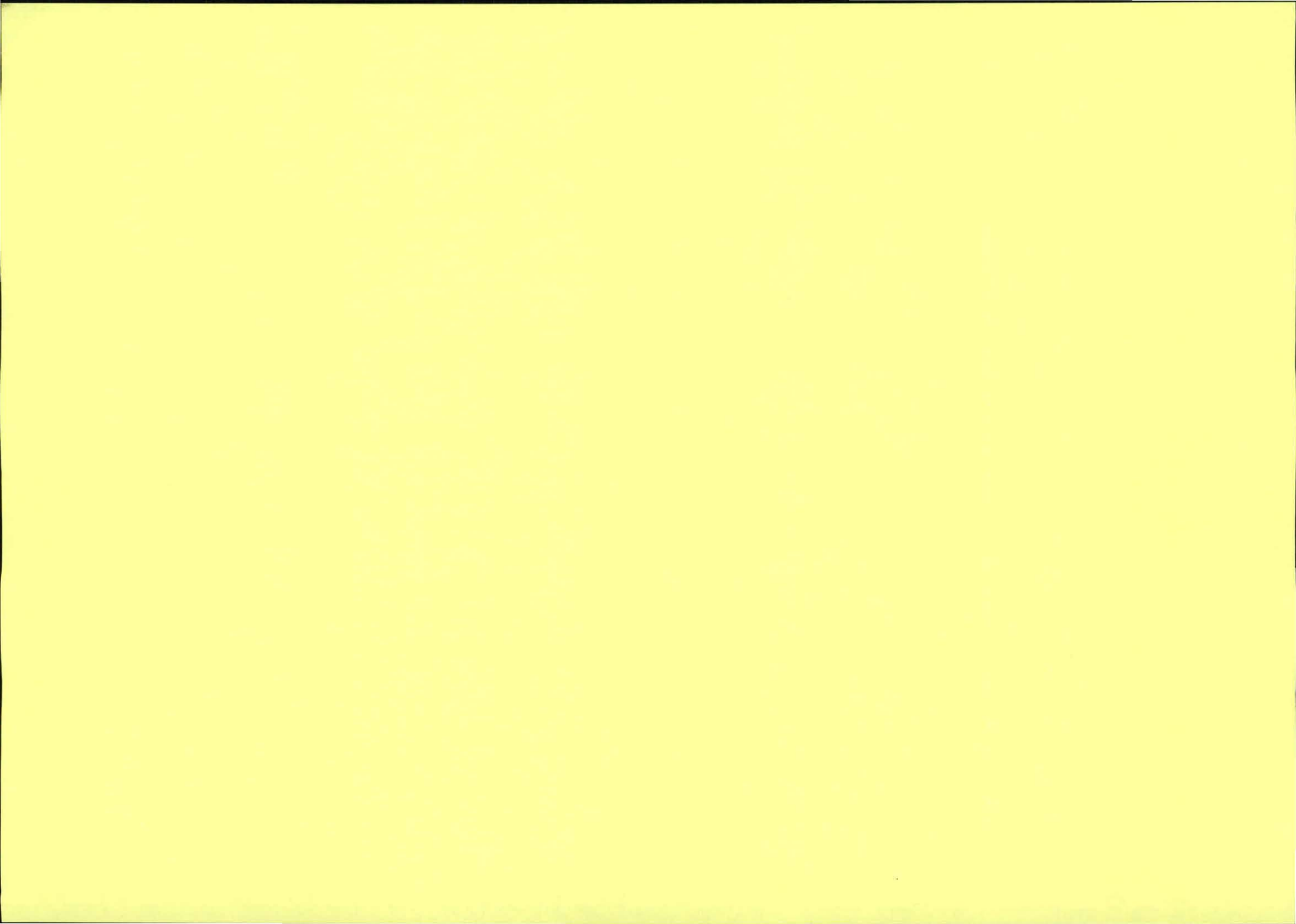
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- Belcher, A. 2009. Freshwater Assessment input into the Environmental Management Plan for Moorreesburg and Malmesbury.
- Belcher, A. 2009. Freshwater Assessment for the Proposed Improvement of Structures along the R27, Section 10 and 11 between Kenhardt and Keimoes.
- Belcher, A. 2010. Freshwater Assessment for the Proposed Improvement of National Route 7 Section 1 between the Melkbos and Atlantis Intersections

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**APPENDIX 4:**

**SPECIALIST REPORT:  
BOTANICAL ASSESSMENT**

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**Botanical Assessment for the proposed  
strengthening (partial reconstruction)  
of National Route 27 Sections 7 & 8 between  
the Western Cape Province/ Northern Cape Province  
Border and Calvinia**



*Report by Dr David J. McDonald  
Bergwind Botanical Surveys & Tours CC.  
14A Thomson Road, Claremont, 7708  
Tel: 021-671-4056  
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**Prepared for CCA Environmental (Pty) Ltd)**

**Client: SANRAL**



## environmental affairs

Department:  
Environmental Affairs  
REPUBLIC OF SOUTH AFRICA

### DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

|                        |                         |
|------------------------|-------------------------|
|                        | (For official use only) |
| File Reference Number: | 12/12/20/               |
| NEAS Reference Number: | DEAT/EIA/               |
| Date Received:         |                         |

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

### PROJECT TITLE

PROPOSED STRENGTHENING (PARTIAL RECONSTRUCTION) OF NATIONAL ROUTE 27 SECTION 7 & 8 BETWEEN WESTERN/ NORTHERN CAPE BORDER (KM 40.0) AND CALVINIA (KM 70.0) - CONTRACT R.027-080-2011/1D

|   |   |              |              |
|---|---|--------------|--------------|
| <b>Specialist:</b>                              | Dr David J. McDonald  |              |              |
| <b>Contact person:</b>                          | Dr McDonald   |              |              |
| <b>Postal address:</b>                          | 14A Thomson Road, Claremont   |              |              |
| <b>Postal code:</b>                             | 7708  | <b>Cell:</b> | 082-876-4051 |
| <b>Telephone:</b>                               | 021-671-4056  | <b>Fax:</b>  | 086-517-3806 |
| <b>E-mail:</b>                                  | dave@bergwind.co.za   |              |              |
| <b>Professional affiliation(s)<br/>(if any)</b> | South African Association of Botanists<br>South African Council for Natural Scientific Professions (Registration No. 400094/06) |              |              |

|                            |  |              |                |
|----------------------------|--|--------------|----------------|
| <b>Project Consultant:</b> | CCA Environmental (Pty) Ltd                                  |              |                |
| <b>Contact person:</b>     | Jonathan Crowther / Ena de Villiers                          |              |                |
| <b>Postal address:</b>     | PO Box 10145, Caledon Square, CAPE TOWN                      |              |                |
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| <b>Telephone:</b>          | (021) 461 1118   | <b>Fax:</b>  | (021) 461 1120 |
| <b>E-mail:</b>             | jonathan@ccaenvironmental.co.za / ena@ccaenvironmental.co.za |              |                |

#### 4.2 The specialist appointed in terms of the Regulations

I, David Jury McDonald, declare that --

##### General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.



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Signature of the specialist:

Bergwind Botanical Surveys & Tours CC

---

Name of company (if applicable):

19 May 2011

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Date:

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# 1. Introduction

## 1.1 Scope

The R27 national road from the border between the Western and Northern Cape Provinces at Vanrhyn's Pass to Calvinia requires strengthening of the existing layers and limited widening. The road route includes approximately 10 km of R27 Section 7 and 70 km of R27 Section 8. A number of culverts and some of the bridges over the Oorlogskloof River that date to the 1950's will require widening and reconstruction. The proposed road works are likely to affect the vegetation in the road-reserve corridor. Road reserves can be important corridors for wildlife and also important repositories for biodiversity (Esler & Milton, 2006). It is therefore necessary to assess the impact of the proposed road-works on the plant communities found in the road reserves along the designated sections of the R 27 and to include a botanical assessment as part of the Environmental Impact Assessment.

The proposed road-works will entail the following activities:

- Re-layering, re-shaping and compaction and re-surfacing of the existing road.
- Re-construction of certain culverts to strengthen them.
- Re-construction of the existing bridges where necessary at the crossings over the Oorlogskloof River, to provide greater road width and increased strength.
- Sourcing of road metal from borrow pits and quarries that will entail further excavation of existing borrow pits.

Bergwind Botanical Surveys & Tours CC (Dr D.J. McDonald) was commissioned to survey and assess the vegetation and habitat found in the road reserves of the above road sections and at seven (7) borrow pits, to inform the process for authorisation to carry out the proposed activities. The assessment takes careful note of the requirements and recommendations of CapeNature (Western Cape Province), Department of Environment Affairs and Nature Conservation, Northern Cape and the Botanical Society of South Africa for proactive assessment of biodiversity of sites where there is a proposed change of land use or potential impact (positive or negative) on natural vegetation. The study follows published guidelines for evaluating potential impacts on the natural vegetation in an area earmarked for some form of development (Brownlie 2005, De Villiers *et al.* 2005) as well as the guidelines for specialists in the Western Cape Province.

## 1.2 Terms of Reference

- Provide a brief outline of the approach used in the study. Assumptions, sources of information and the difficulties with predictive models must also be clearly stated.
- If applicable, provide a brief description of any consultation process that was undertaken, as well as a brief description and copies of any comments that were received during any consultation process.

### 1.2.1 General Terms of Reference:

- Review previous work done in the area and describe the baseline conditions that exist in the study area.
- Provide a full assessment report on any sensitive areas identified in the road reserve as well as the seven borrow pit sites and four bridge sites.
- Identify and assess potential impacts of the construction, operational and closure/decommissioning phases, as relevant in the case of each site. To ensure that specialists use a common standard, the determination of the significance of the assessed impacts will be undertaken in accordance with CCA Environmental's Convention for Assigning Significance Ratings to Impacts (Appendix1). A table template for reporting on impact assessment is provided in Attachment C for use in assessment reports.
- Identify feasible ways in which impacts could be mitigated and benefits enhanced giving an indication of the likely effectiveness of such mitigation and how these could be implemented in the construction and management of the proposed development.
- Identify and assess any cumulative impacts arising from the proposed project.
- Identify and list all legislation and permit requirements that are relevant to the development proposal in the specific field of expertise, and provide guidance for compliance with any relevant legislation.

- Indicate the reliability of information utilised in the assessment of impacts, as well as any constraints to which the assessment was subjected (e.g. any areas of insufficient information or uncertainty).
- Indicate whether any of these areas of insufficient information or uncertainty associated with the specialist study would impact on the decision whether or not to authorise the proposed project.
- Comply with guidelines on specialist study requirements for EIA provided by the Department of Environmental Affairs (DEA) and the Department of Environmental Affairs and Development Planning (DEA&DP) of the Western Cape Province, as well as the requirements listed in Sections 17 and 32(2) of the EIA Regulations 2010 dated 18 June 2010 promulgated in terms of Chapter 5 of NEMA.

### **1.2.2 Specific Terms of Reference for Botanical Assessment**

- Provide a broad, baseline description of the vegetation of the study area, placing it in a regional context. Reference should also be made to any bioregional maps of the area.
- Map the vegetation communities and associated conservation value/sensitivity of the study area and identify any areas of specific concern (e.g. high sensitivity and/or conservation status).
- Provide guidance on any permits that would be required from any organ of state in respect of the conservation or removal of vegetation in the study area.
- Provide specific information relating to the vegetation of each borrow pit and bridge site, with reference to any species of special concern and their conservation status, which can be used as baseline information for the assessment of potential impacts of the proposed project.
- Investigate ecological/biodiversity processes that could be affected by the proposed project.
- Identify, describe and assess the impacts of the proposed activities and any activity alternatives on the vegetation.

- Recommend appropriate, practicable mitigation measures that will reduce all major (significant) impacts or enhance potential benefits, if any.



Figure 1. Location of the R27 route between Vanrhyn's Pass (at the boundary between Western and Northern Cape Provinces) and Calvinia.

### 1.3 Assumptions and Limitations

The Hantam region where the study area is situated is subject mainly to winter rainfall but also benefits from occasional rain showers and thunderstorms in the summer. Most of the flora therefore is winter-growing with a flush of flowering in the spring. The principal limitation of the present survey was the season in which the survey was conducted. Early winter rain had been experienced at Nieuwoudtville and Calvinia shortly before and during the survey period but this had not yet influenced the winter growth of the plants. Consequently most plant species appeared drought-stressed and in poor condition, with very few flowers, at the time of the field

sampling. Despite this, it was possible to successfully identify most of the shrub species and some of the herbaceous species. Geophytes, if present, were generally not yet evident apart from *Brunsvigia bosmaniae*. The presence of this species was made obvious by the mature inflorescences (tumble-weed seed capsules) and in some places early 'new' leaves.

### 3. Project Area

#### 3.1 Locality

Approximately 30 km east of Vanrhynsdorp the land rises sharply from the lowlands at more-or-less 200 m above mean sea level (a.m.s.l.) to 800 m on the Bokkeveld Escarpment. The boundary between the Western Cape Province and the Northern Cape Province is on the escarpment. The R27 National Route runs due east from Vanrhynsdorp, climbs the escarpment at Vanrhyn's Pass and then continues eastwards past Nieuwoudtville, which lies approximately 10 km from the edge of the escarpment, inland across the Bokkeveld Plateau to Calvinia which is at the foot of the Hantamsberge, 70 km from Nieuwoudtville (Figures 1 – 3). The last  $\pm$  10 km of the R27 Section 7 and R 27 Section 8 fall within the Northern Cape Province but the road is administered by South African National Roads Agency Limited (SANRAL) as a national route.

As noted above the project has two aspects (1) the survey of the road reserve from Vanrhyn's Pass to Calvinia and (2) the investigation of seven borrow pits for road-making materials. The road is by nature a linear feature and is well defined. The borrow pits investigated for possible extension are located at intervals along the road route as described above and are found at the localities given in Table 1. One of the borrow pits (R27-8 km 32.6 RHS 6.2) is at an abandoned mine.

**Table 1. Location of borrow pits**

| Borrow Pit No.              | Latitude        | Longitude       |
|-----------------------------|-----------------|-----------------|
| R27-7 km 51 LHS 6.9 (BP1)   | S 31° 20' 01.3" | E 19° 07' 06.1" |
| R27-8 km 9.5 LHS 0.2 (BP2)  | S 31° 23' 57.7" | E 19° 12' 40.3" |
| R27-8 km 32.6 RHS 6.2 (BP3) | S 31° 32' 15.4" | E 19° 24' 11.9" |
| R27-8 km 39.8 LHS 0.1 (BP4) | S 31° 29' 26.4" | E 19° 29' 28.3" |
| R27-8 km 45.0 RHS 0.2 (BP5) | S 31° 29' 43.7" | E 19° 32' 44.7" |

|                             |                 |                 |
|-----------------------------|-----------------|-----------------|
| R27-8 km 50.4 LHS 0.1 (BP6) | S 31° 29' 43.0" | E 19° 36' 08.2" |
| R27-8 km 61.6 RHS 1.0 (BP7) | S 31° 30' 35.3" | E 19° 43' 00.0" |

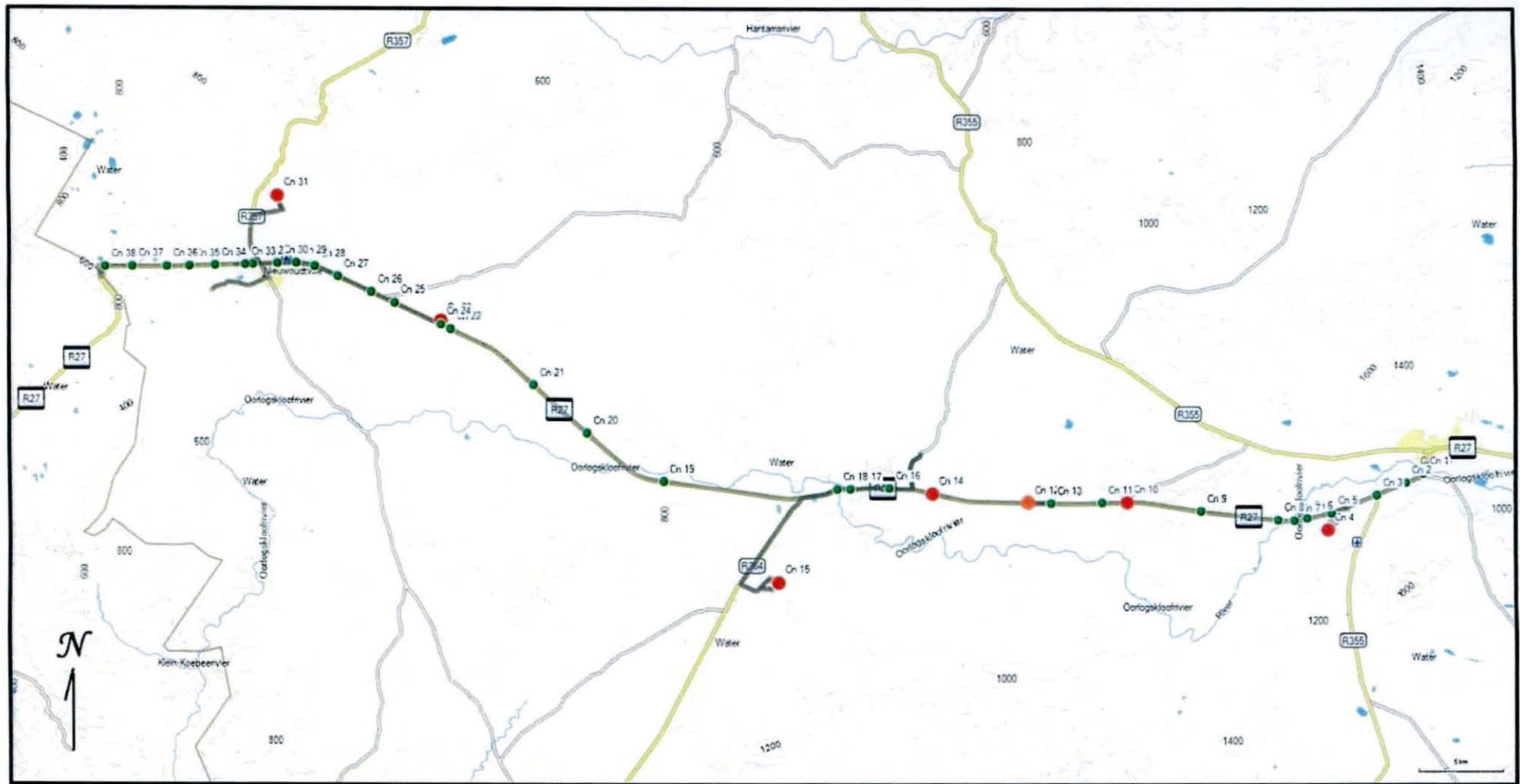


Figure 2. Topographical map of the area through which the R27 Sections 7 & 8 route passes. Waypoints with green icons were those along the road route and those with red icons are the proposed borrow pits.



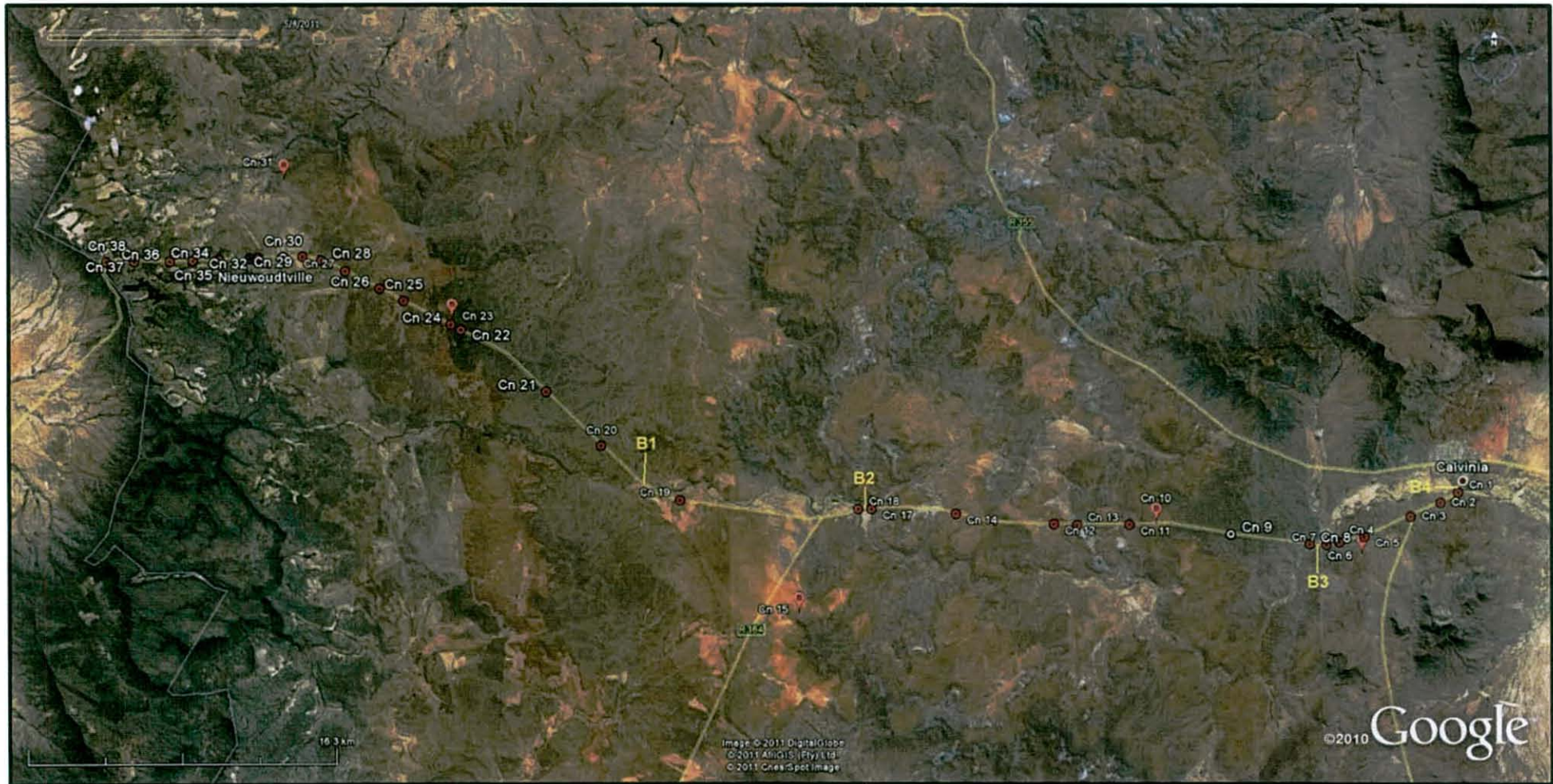
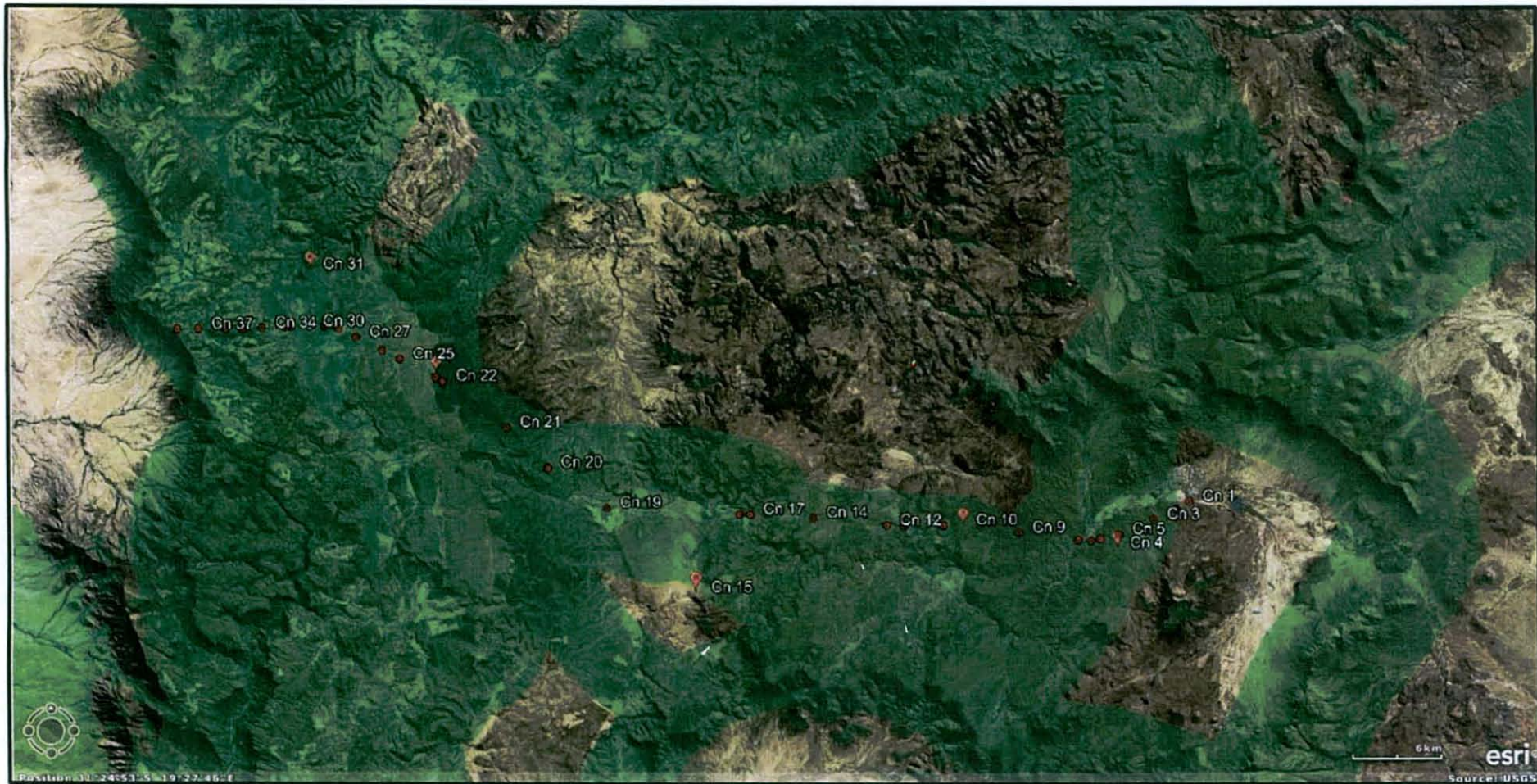
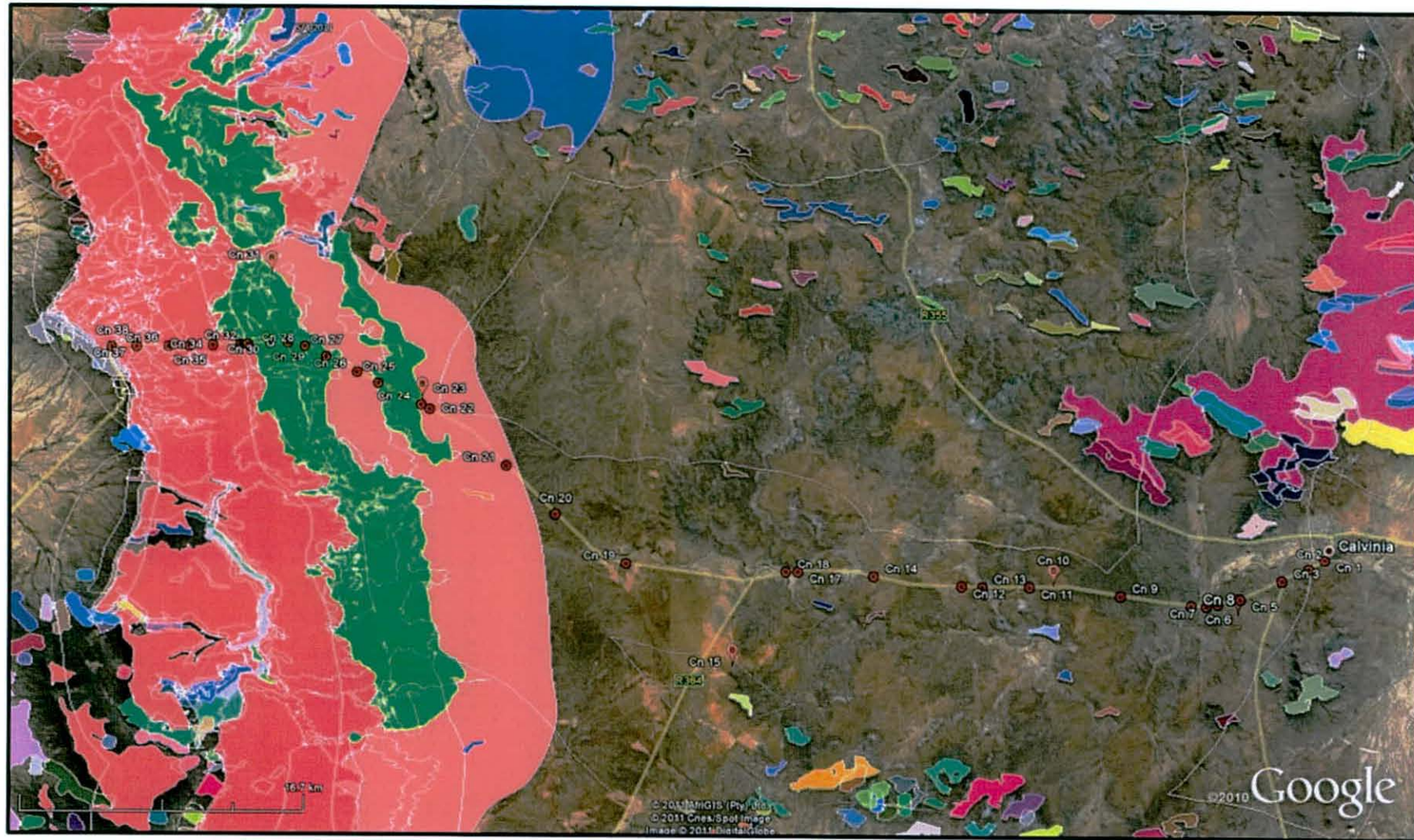


Figure 3. The R27 Sections 7 & 8 route between Vanrhyn's Pass in the west and Calvinia in the east showing the sample waypoints Cn# with red dots, the proposed borrow pits (pink tear-drop icons) and the four bridges B1 – B4 (yellow), superimposed on a Google Earth © aerial image of the study area.



**Figure 4.** Portion of the mapped Critical Biodiversity Areas (CBA's) and Ecological Support Areas (ESA's) for Namaqualand District Municipality – shown together as green shading. The sample waypoints (CN#) are superimposed and those from CN1 – CN20 fall within an ESA corridor. Those from CN21 – CN38 fall within a Critical Biodiversity Area (refer to Figure 5).



**Figure 5.** Aerial view (Google Earth ©) of the study area with Critical Biodiversity Areas (CBA's) superimposed. All waypoint samples CN21—CN38 i.e. from the occurrence of Nieuwoudtville—Roggeveld Dolerite Renosterveld (dark pink) westwards through Nieuwoudtville Shale Renosterveld (lime green) and Bokkeveld Sandstone Fynbos (Red) fall within CBA's.

### 3.2 Landscape, Geology, Topography and Soils

The ascent of the Bokkeveld Escarpment at Vanrhyn's Pass takes one through a series of strata; the Malmesbury, Table Mountain and Bokkeveld Groups of the Cape Supergroup. The sandstone sediments of the Nardouw Sub-group (Table Mountain Group) give rise to acid, sandy soils found on the edge of the Bokkeveld Escarpment. These give way further inland to the Dwyka Group (tillites) (Karoo Supergroup) that have a fine-grained matrix and weather to clay-rich soils. In the study area the Dwyka Group is sandwiched in a north-south band between the sandstone sediments of the Cape Supergroup and the dolerites found around Nieuwoudtville. Ecca Group (shales) and to a lesser extent Dwyka tillites of the Karoo Supergroup give rise to clay-rich soils typical of the large undulating open areas of the Hantam between Nieuwoudtville and Calvinia. These sedimentary strata were intruded by igneous lavas of the Karoo Dolerite Suite (Manning & Goldblatt, 2007; Rebelo *et al.* 2006 in Mucina & Rutherford, 2006).

Dolerite koppies and open areas of doleritic soils are characteristic of the area around Nieuwoudtville and on the Hantam Plateau. During the Jurassic Period (180 – 135 mya) when there was major volcanic activity prior to the break-up of the Gondwana super-continent, igneous dolerite was deposited over or intruded into vast areas of sedimentary strata in the Karoo. Over time the dolerite dykes and sills have been exposed by weathering of the softer shales and sandstones. On level land surfaces the dolerite has weathered to form clay-rich (swelling clays) red soils of the Arcadia Form. On steeper slopes where weathering is more limited, shallow Glenrosa and Hutton Form soils develop. Owing to the low rainfall in the Hantam the dolerite-derived soils are base-saturated with a neutral pH.

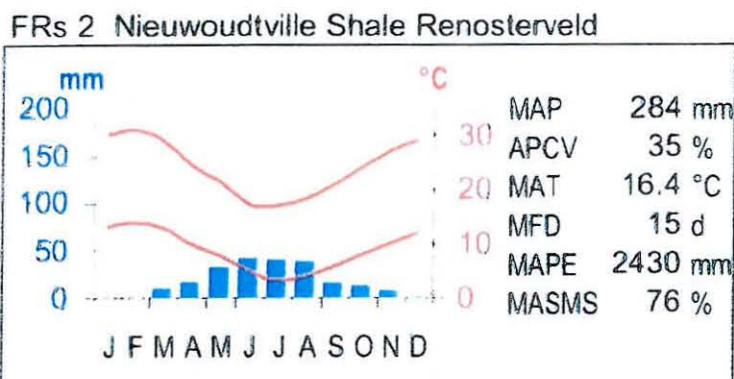
Dolerite is notably found at the abandoned mine mentioned above (page 7) as well as at some of the identified borrow pits east of Nieuwoudtville.



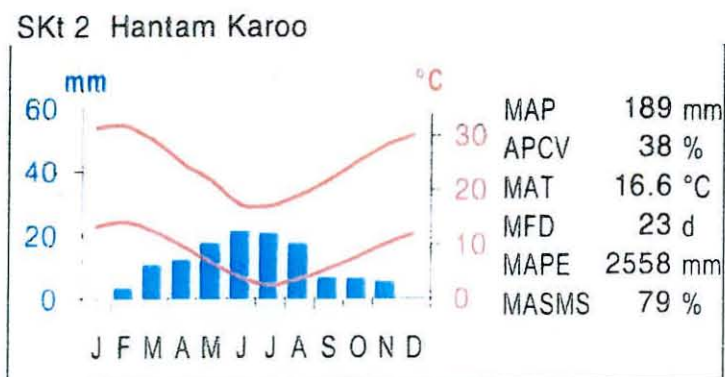
**Figure 6.** A typical dolerite 'koppie' outcrop near Nieuwoudtville with characteristic red soil.

### 3.3 Climate

The climate of the Hantam Karoo and that of the Nieuwoudtville area in the west is a winter-rainfall area with most rain occurring in the months of May to August, peaking in June (Figures 7&8). Very little rain occurs in December, January and February but late summer showers and thunderstorms can provide relief to the high daytime temperatures. The area around Nieuwoudtville experiences a mean annual precipitation (MAP) of 284 mm which is almost 100 mm more than the more arid central Hantam which has a MAP of 189 mm. Evaporation demand both in the air and soil is also somewhat higher in the central Hantam than at Nieuwoudtville which further accounts for its more arid character. The annual cycle of temperatures is similar from Nieuwoudtville eastwards to Calvinia with mean annual temperature (MAT) around 16°C. Frost is also more prevalent in the central Hantam (23 days *per annum*) than at Nieuwoudtville (15 days *per annum*) (Rebello *et al.*, 2006)



**Figure 7.** Climate diagram for Nieuwoudtville Shale Renosterveld which represents the climate for the Nieuwoudtville area. MAP = Mean Annual Precipitation; APCV = Annual Precipitation Coefficient of Variation; MAT = Mean Annual Temperature; MFD = Mean Frost Days per annum; MAPE = Mean Annual Potential Evaporation; MASMS = Mean Annual Soil Moisture Stress (from Mucina & Rutherford, 2006).



**Figure 8.** Climate diagram for the Hantam Karoo (see Figure 7 for legend) (from Mucina & Rutherford, 2006).

## 4. Evaluation Method

The R27 National Road Route, Sections 7 & 8 were visited on 2, 3 & 4 May 2011 at the beginning of winter after the first winter rains. The preceding summer had been dry as stated above and a limitation was that the vegetation had not yet had time to recover and benefit from the rain after the long period of, hot dry conditions. However, adequate plant material, sometimes in a dry state, was available over most of the survey route to be able to make meaningful observations.

The route from Vanrhyn's Pass to Calvinia was initially travelled by vehicle on 2 May 2011 to obtain an 'overview impression' of the vegetation in the road reserves. Over the following two days the route was travelled in reverse during which time the borrow pits were also visited and evaluated. Regular stops were made along the R27 route at which waypoints were recorded with observations and photographs of the vegetation.

## 5. Results

### 5.1 The Vegetation

Biogeographically the study area falls partly within the Fynbos Biome (Mucina & Rutherford, 2006) in the west and mostly within the Succulent Karoo Biome (Van Wyk & Smith, 2005; Mucina & Rutherford, 2006). A sequence of vegetation types occurs from west to east from the Bokkeveld Escarpment inland to Calvinia. This is described in broad terms in the national classification of the vegetation of South Africa (Rebelo *et al.* 2006). The vegetation of the Bokkeveld Escarpment on sandstone-derived soils has higher rainfall than that found further inland to the east. It is 'true fynbos' and is classified as Bokkeveld Sandstone Fynbos (FFs1). On the clay-rich soils derived from Dwyka sediments the vegetation is Nieuwoudtville Shale Renosterveld (FRs2). Next in the sequence is Nieuwoudtville-Roggeveld Dolerite Renosterveld (FRd1), in a narrow north-south band which is widest in the north and tapers southwards to terminate south of the Oorlogskloof River. East of the exposures of dolerite and dolerite-derived soils the vegetation is classified as Hantam Karoo (SK2) on the clay-rich soils to Calvinia and beyond (Figure 9).

In a study of the vegetation of the Hantam-Tanqua-Roggeveld subregion (Van der Merwe *et al.* (2008a & b) described the vegetation associations or communities found in more detail and mapped these associations as in Figure 10. They did not include the Bokkeveld Sandstone Fynbos in their study, only the Succulent Karoo vegetation. Along

the west to east gradient from Nieuwoudtville to Calvinia, six mapped vegetation are encountered following the classification of Van der Merwe *et al.* (2008a & b). Two of these units, the Nieuwoudtville Mosaic, Grootfontein Mosaic and Calvinia Mosaic each comprise more than one vegetation association. This level of detail is beyond the scope of this study and the reader is referred to the original papers of Van der Merwe *et al.* (2008a & b) should more detail be required. In west to east order these vegetation units are:

1. Nieuwoudtville Mosaic
2. Grootfontein Mosaic
3. *Leipoldtia schulzei* – *Eriocephalus purpureus* Hantam Karoo
4. *Erodium cicutarium* – *Eriocephalus purpureus* Hantam Karoo
5. *Eriocephalus ericoides* – *Pteronia glomerata* Roggeveld Karoo
6. Calvinia Mosaic

## 5.2 Vegetation units and disturbance regime of the road reserve of the R27, Sections 7 & 8.

The vegetation encountered at the sample waypoints has been assigned to the above six units based on geographical position and the species composition of the vegetation at the respective waypoints and borrow pits. The condition of the vegetation was evaluated as well, as given in the brief notes in Table 2.

Historically the vegetation of the road reserve between Vanrhyn's Pass and Calvinia has been heavily impacted by various negative activities but most of all by removal of natural vegetation under the banner of 'maintenance'. This has been documented by Prof Sue Milton (Esler & Milton, 2006) in observations along the R27 in March 2005 (see Appendix 2) where work teams were removing natural shrub vegetation to ostensibly (1) improve road safety, (2) improve visibility, (3) simplify maintenance, and (4) create jobs. Clearly this activity has had a long-term negative effect since six years later the vegetation has not recovered to its former state. The road-verge along virtually the whole length of the surveyed sections is regularly mowed and the vegetation between the 1–2 m verge and the fence, within the road reserve, is in poor condition over considerable distances. The negative impact of the historical clearing of vegetation has undoubtedly compromised the value of the R27 road-reserve as a biodiversity corridor and efforts must be made to curtail the negative activities and promote a better understanding of the value of the roadside habitat.

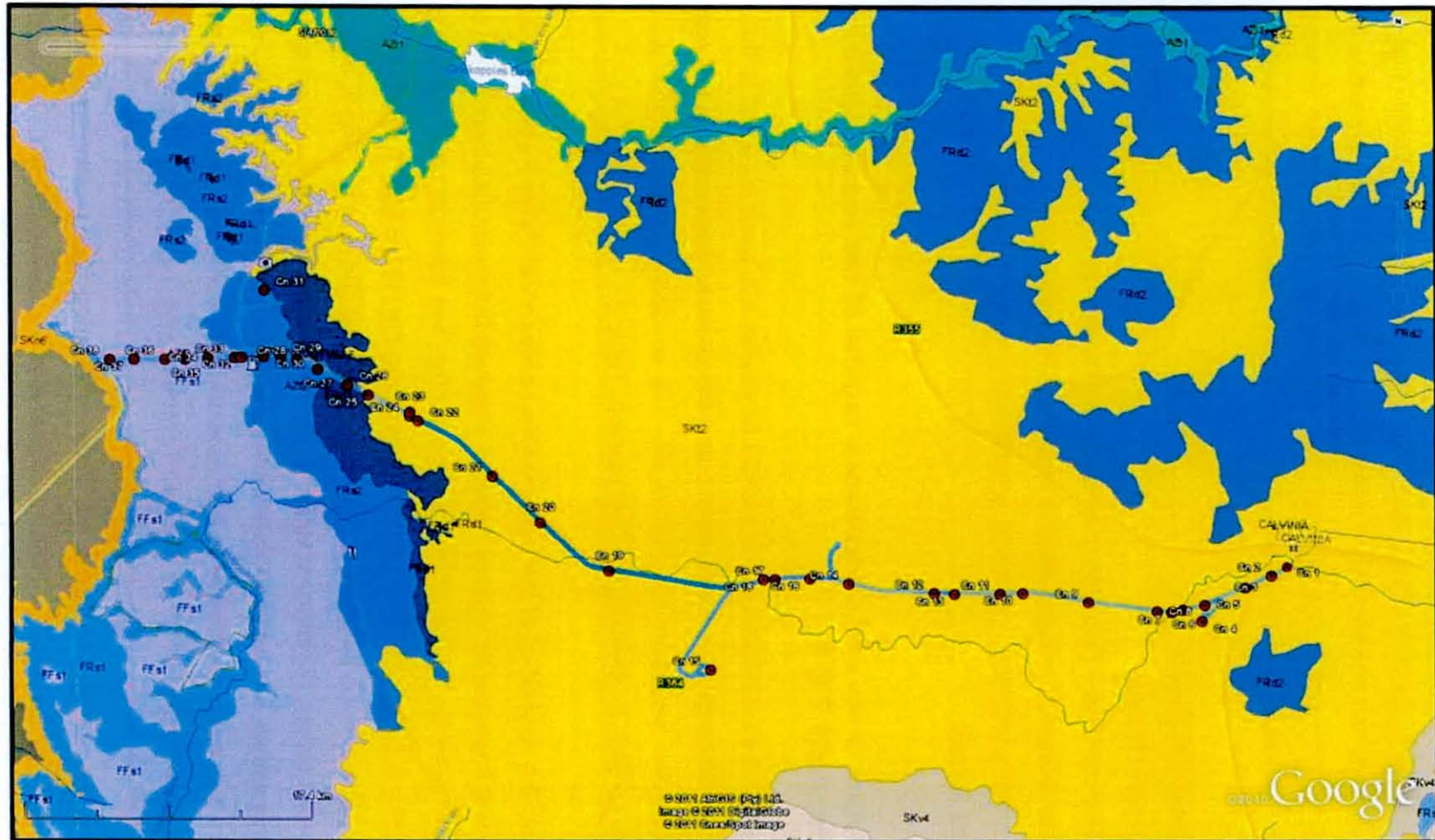


Figure 9. Portion of the Vegetation Map of South Africa, Lesotho & Swaziland (Mucina *et al.* 2005), showing the various vegetation types found along the R27 Sections 7 & 8, Northern Cape Province: FFs1 (mauve)—Bokkeveld Sandstone Fynbos; FRs2 (light blue) – Nieuwoudtville Shale Renosterveld; FRd1 (dark blue) – Nieuwoudtville – Roggeveld Dolerite Renosterveld; SKt2 (yellow) – Hantam Karoo. The blue line is the survey route with waypoints CN#.



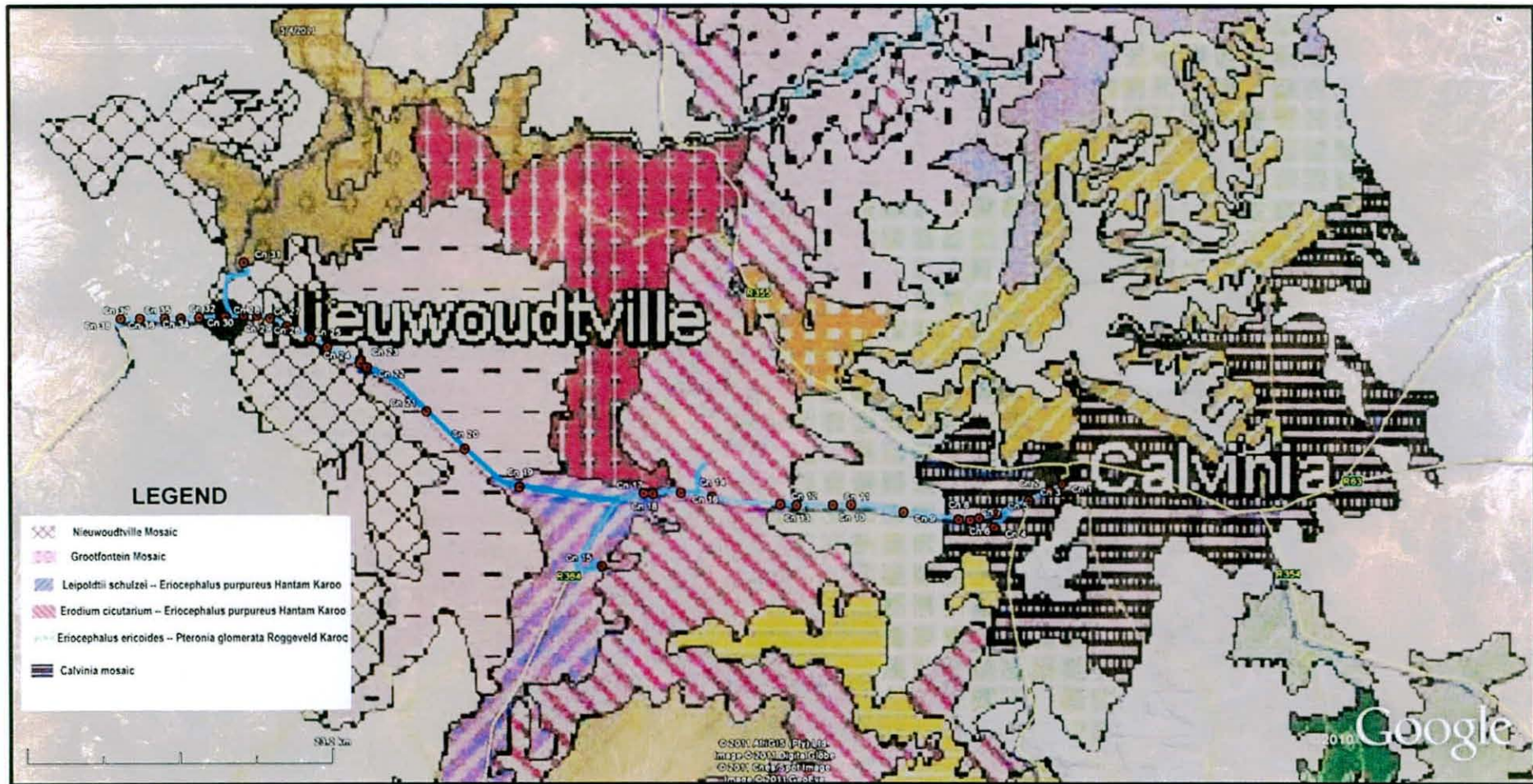










Figure 10. Portion of vegetation map of Nieuwoudtville – Calvinia from Van der Merwe *et al.* (2008b). The blue line is the survey route with waypoints CN#.



**Table 2. Waypoints with descriptions of vegetation and illustrative photographs for Sections 7 and 8 of the R 27 National Route, Northern Cape Province. Vegetation Unit in green type follows Vander Merwe *et al.* classification and unit in red type the national classification.**



| Waypoint  | Vegetation Unit *  | Brief descriptive notes  |  |
|---|--|--|--|
| <p><b>CN1</b><br/>S 31° 28' 48.3"<br/>E 19° 46' 14.0"</p> | <p><b>Calvinia Mosaic</b><br/><br/><b>Hantam Karoo</b></p> | <p>At the Keiskie turnoff outside Calvinia. The road reserve is highly disturbed on both sides of the road. The vegetation consists mainly of weeds such as <i>Salsola kali</i> (rolbos), <i>Atriplex semibaccata</i>, <i>Atriplex lindleyi</i> subsp. <i>inflata</i>, <i>Malephora crassa</i>, <i>Salsola</i> sp., <i>Ruschia</i> sp., <i>Chrysocoma ciliata</i>, <i>Galenia africana</i> and <i>Gazania krebsiana</i>.</p> |   |
| <p><b>CN2</b><br/>S 31° 29' 05.8"<br/>E 19° 45' 38.9"</p> | <p><b>Calvinia Mosaic</b><br/><br/><b>Hantam Karoo</b></p> | <p>Near road marker R27-8 66.0 E. A culvert is found here and both side of the road are disturbed and vegetated mainly with weedy species. <i>Galenia africana</i> is prominent. Other species include <i>Salsola kali</i>, <i>Eragrostis</i> sp., <i>Sonchus oleraceus</i>, <i>Fingerhuthia africana</i>, <i>Felicia muricata</i>, <i>Erodium cicutarium</i>, and <i>Cucumis myriocarpus</i> subsp. <i>leptodermis</i>.</p> |  |



|   |  |  |  |
|---|--|--|--|
| <p><b>CN3</b><br/>S 31° 29' 29.5"<br/>E 19° 44' 39.1"</p> | <p><b>Calvinia Mosaic</b><br/><br/><b>Hantam Karoo</b></p> | <p>This waypoint is at the R 355 / R 27 intersection at R27-8 64.2 E. The road reserve close to the road on both sides is highly disturbed with abundant weeds. <i>Galenia africana</i> is prevalent with <i>Cucumis myriocarpus</i> subsp. <i>leptodermis</i> present. On the south-west side of the intersection is a stand of <i>Eriosephalus</i> sp. together with <i>Ruschia</i> cf. <i>intricata</i>, <i>Psilocaulon junceum</i> and <i>Osteospermum</i> sp.</p> |   |
| <p><b>CN5</b><br/>S 31° 30' 03.7"<br/>E 19° 43' 06.3"</p> | <p><b>Calvinia Mosaic</b><br/><br/><b>Hantam Karoo</b></p> | <p>This waypoint is at the entrance to the track to Borrow Pit 7 near road marker R27-8 61.2E. The vegetation on both sides of the road is in poor condition when compared with the vegetation on the adjacent private property.</p>   |  |

|   |  |  |  |
|---|--|--|--|
| <p><b>CN6</b><br/>S 31° 30' 13.6"<br/>E 19° 42' 16.3"</p> | <p><b>Calvinia Mosaic</b><br/><br/><b>Hantam Karoo</b></p> | <p>At the R27-8 60.2E marker. As at most places the vegetation near the edge of the road is most disturbed (mowed) whereas closer to the fence it is shrubby with numerous weedy species. Species recorded include, <i>Chrysocoma ciliata</i>, <i>Pentzia incana</i>, <i>Drosanthemum</i> sp., <i>Osteospermum</i> sp., <i>Erioccephalus ericoides</i>, <i>Felicia</i> sp. <i>Salvia</i> sp. <i>Stipagrostis namaquense</i>, <i>Lycium</i> sp. <i>Hermannia</i> sp., <i>Atriplex semibaccata</i>, <i>Galenia sarcophylla</i>, <i>Tetragonia</i> sp., <i>Oxalis pes-caprae</i>, <i>Galenia africana</i>, <i>Mesembryanthemum guerichianum</i>, <i>Salsola kali</i>, <i>Fingerhuthia africana</i>, <i>Ceratotheca triloba</i>.</p> |   |
| <p><b>CN7</b><br/>S 31° 30' 18.2"<br/>E 19° 41' 50.4"</p> | <p><b>Calvinia Mosaic</b><br/><br/><b>Hantam Karoo</b></p> | <p>Lay-by area on north side of road at R 27-8 59.4E which is highly disturbed. Piles of gravel are present and the area is used for road-works. The south side of the road has short shrubby vegetation with a mowed grassy verge.</p>  |  |



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|---|---|--|--|
| <p><b>CN8</b><br/>S 31° 30' 16.9"<br/>E 19° 41' 16.9"</p> | <p><b>Calvinia Mosaic</b><br/><b>Hantam Karoo</b></p> | <p>A steep slope is found on the south side of the road here, near marker R27-8 58.6E. Owing to the road fill the vegetation is weedy.</p>   |   |
|   | <p><b>Calvinia Mosaic</b><br/><b>Hantam Karoo</b></p> | <p>On the north side at waypoint CN8 the road cuts through shale sediments. The vegetation on the road verge is weedy but closer to the fence is less disturbed and is continuous with the natural community on the adjacent private property.</p> |  |



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| <p><b>CN9</b><br/>S 31° 29' 59.9"<br/>E 19° 38' 39.0"</p>  | <p><i>Ericephalus ericoides</i> –<br/><i>Pteronia glomerata</i><br/>Roggeveld Karoo<br/><br/>Hantam Karoo</p> | <p>This location is at road marker R27-8 54.4E. The road is straight for a long distance with the road verge cleared of most vegetation except low grasses. Beyond the road verge within the road reserve is low shrubland that extends over a wide area both north and south of the road.</p> |   |
| <p><b>CN11</b><br/>S 31° 29' 44.1"<br/>E 19° 35' 16.1"</p> | <p><i>Ericephalus ericoides</i> –<br/><i>Pteronia glomerata</i><br/>Roggeveld Karoo<br/><br/>Hantam Karoo</p> | <p>This waypoint is at R 27-8 49.0E. The road reserve on the south side is narrower than the north side and is highly disturbed.</p>   |  |




|   |  |   |  |
|---|--|---|--|
|   | <p><i>Eriocephalus ericoides</i> –<br/><i>Pteronia glomerata</i><br/>Roggeveld Karoo</p> <p>Hantam Karoo</p> | <p>On the north side at waypoint CN11 the vegetation beyond the verge is mowed but less disturbed close to the fence where there is typical low shrubland or “bossieveld”. <i>Brunsvigia bosmaniae</i> was found at this location</p> |   |
| <p>CN13<br/>S 31° 29' 45.4"<br/>E 19° 33' 31.2"</p> | <p><i>Eriocephalus ericoides</i> –<br/><i>Pteronia glomerata</i><br/>Roggeveld Karoo</p> <p>Hantam Karoo</p> | <p>Typical view of private property with low Karoo “bossieveld” – fairly heavily grazed -- to the south of entrance gate off the R27 to the proposed dolerite quarry.</p>   |  |



|  |   |  |  |
|--|---|--|--|
| <p><b>CN16</b><br/>S 31° 29' 17.0"<br/>E 19° 27' 59.3"</p> | <p><i>Erodium cicutarium</i> –<br/><i>Eriosephalus purpureus</i><br/><b>Hantam Karoo</b></p> <p><b>Hantam Karoo</b></p> | <p>At road marker R27-8 37.4E. The road reserve on the north side (opposite) is narrower than that on the south side (below right). As is mostly the case, the vegetation on the road verge (both sides) is highly disturbed and grassy. Closer to the fence the vegetation is low "bossieveld" dominated by succulent shrubs (Aizoaceae) and composite shrubs (Asteraceae).</p> |   |
|  | <p><i>Erodium cicutarium</i> –<br/><i>Eriosephalus purpureus</i><br/><b>Hantam Karoo</b></p> <p><b>Hantam Karoo</b></p> | <p>View of the south side of the R27 at waypoint CN16.</p>   |  |







|   |  |  |   |
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|   | <p><i>Erodium cicutarium</i> –<br/><i>Eriocephalus purpureus</i><br/>Hantam Karoo</p> <p>Hantam Karoo</p>  | <p>Near waypoint CN16 the road cuts through shale sediments of the Ecca Group.</p>   |  |
| <p>CN17<br/>S 31° 29' 18.8"<br/>E 19° 26' 39.1"</p> | <p><i>Leipoldtia schulzei</i> –<br/><i>Eriocephalus purpureus</i><br/>Hantam Karoo</p> <p>Hantam Karoo</p> | <p>At the entrance to the farm Toekoms which is near the bridge built in 1959 over the Oorlogskloof River. The vegetation in the road reserve on the south side is highly disturbed with a suite of weedy species. On the north side of the road the vegetation is less disturbed, consisting of typical low 'bossieveld' where it has not been mowed.</p> |  |



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| <p><b>CN18</b><br/>S 31° 29' 18.9"<br/>E 19° 26' 12.5"</p> | <p><i>Leipoldtia schulzei</i> –<br/><i>Erioccephalus purpureus</i><br/>Hantam Karoo<br/><br/>Hantam Karoo</p> | <p>This waypoint is a short distance to the west of the 1959 Oorlogskloof River bridge. On both the south (see photo) and north sides of the road there are dense stands of <i>Salsola aphylla</i> (gannabos), extending to the river banks at the bridge. On the north side there are also numerous mesquite trees (<i>Prosopis glandulosa</i>).</p> |  |
| <p><b>CN19</b><br/>S 31° 29' 03.9"<br/>E 19° 20' 16.1"</p> | <p><i>Leipoldtia schulzei</i> –<br/><i>Erioccephalus purpureus</i><br/>Hantam Karoo<br/><br/>Hantam Karoo</p> | <p>At road marker R27-8 25 E. A change in the vegetation was noted at this waypoint. It is noticeably taller and dominated by <i>Pteronia pallens</i>. Other species include <i>Psilocalon junceum</i>, <i>Zygophyllum</i> sp., <i>Ruschia intricata</i>, <i>Atriplex lindleyi</i> subsp. <i>inflata</i>, <i>Salsola tuberculata</i>.</p>             |  |

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|   | <p><i>Leipoldtia schulzei</i> –<br/><i>Eriocephalus purpureus</i><br/>Hantam Karoo</p> <p>Hantam Karoo</p> | <p>Calcrete is found in the soil here on the south side of the road at waypoint CN19. This correlates well with the presence of <i>Pteronia pallens</i>.</p>  |   |
| <p>CN20<br/>S 31° 27' 31.4"<br/>E 19° 17' 38.6"</p> | <p>Grootfontein Mosaic</p> <p>Hantam Karoo</p>   | <p>At the R27-8 19.8E road marker the vegetation in the road reserve is highly disturbed with <i>Galenia africana</i>, <i>Augea capensis</i> and <i>Pentzia incana</i> prominent. Other species include <i>Ruschia</i> sp., <i>Eriocephalus ericoides</i>, <i>Asparagus</i> sp., <i>Salsola kali</i> and <i>Erodium cicutarium</i>.</p>   |   |
| <p>CN21<br/>S 31° 26' 00.3"<br/>E 19° 15' 49.3"</p> | <p>Grootfontein Mosaic</p> <p>Hantam Karoo</p>   | <p>Approximately 20km east of Nieuwoudtville westwards the road has been resurfaced. At the R27-8 19.8E road marker the vegetation in the road reserve is highly disturbed from the edge of the road up to the fence. There appears to be a correlation between the newer road surface and the roadside disturbance. The vegetation is dominated by grasses, <i>Galenia africana</i> and <i>Salsola kali</i>, all indicating the high level of disturbance.</p> |  |

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| <p><b>CN22</b><br/>S 31° 24' 14.6"<br/>E 19° 12' 59.3"</p> | <p><b>Grootfontein Mosaic</b><br/><br/><b>Hantam Karoo</b></p>   | <p>At the R27-8 10.2E road marker the road reserve is mowed almost to the fence. A 'row' of <i>Ruschia</i> sp. shrubs about 1m wide is found along the fence. <i>Brunsvigia bosmaniae</i> is present; being a geophyte it survives the mowing. Even <i>Galenia africana</i> is sparse at this location.</p>  |   |
| <p><b>CN24</b><br/>S 31° 24' 05.5"<br/>E 19° 12' 39.6"</p> | <p><b>Nieuwoudtville Mosaic</b><br/><br/><b>Hantam Karoo</b></p> | <p>At road marker R27-8 9.6E (near Borrow Pit 2). The road reserve on both sides is highly disturbed. On the north side the road verge is mowed for width of 5 m. The natural shrubby vegetation is dominated by <i>Pentzia incana</i>. Other species include <i>Augea capensis</i>, <i>Chrysocoma ciliata</i>, <i>Stipagrostis namaquense</i>, <i>Eragrostis curvula</i>, <i>Oxalis pes-caprae</i>, <i>Mesembryanthemum guerichianum</i>, <i>Galenia africana</i>, <i>Atriplex semibaccata</i>.</p> |  |

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| <p><b>CN25</b><br/>S 31° 23' 25.1"<br/>E 19° 11' 04.8"</p> | <p><b>Nieuwoudtville Mosaic</b><br/><br/><b>Hantam Karoo</b></p>  | <p>This location is at the R27-8 6.8E road marker where the road reserve is highly disturbed. The vegetation is principally dry annual grasses with <i>Psilocalon junceum</i>, <i>Lycium</i> sp., <i>Asparagus capensis</i>, <i>Atriplex nummularia</i>, <i>Atriplex semibaccata</i>, <i>Salsola kali</i>, <i>Mesembryanthemum guerichianum</i> and <i>Brunsvigia bosmaniae</i>.</p>   |  |
| <p><b>CN26</b><br/>S 31° 23' 04.7"<br/>E 19° 10' 17.2"</p> | <p><b>Nieuwoudtville Mosaic</b><br/><br/><b>Nieuwoudtville—<br/>Roggeveld Dolerite<br/>Renosterveld</b></p> | <p>At this road marker (R27-8 5.4E) the soil is derived from dolerite. The vegetation has numerous species but shows signs of intense disturbance. Species recorded include <i>Brunsvigia bosmaniae</i>, <i>Boo phone haemanthoides</i>, <i>Chrysocoma ciliata</i>, <i>Oxalis</i> sp. (pink flowers), <i>Trachyandra</i> cf. <i>falcata</i>, <i>Asparagus capensis</i>, <i>Berkheya</i> sp., <i>Oxalis</i> sp. (yellow flowers), <i>Salsola kali</i>, <i>Psilocalon junceum</i>, <i>Malephora crassa</i>, <i>Atriplex semibaccata</i>, <i>Eragrostis curvula</i>, <i>Hermannia</i> sp.</p> |  |

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| <p><b>CN27</b><br/>S 31° 22' 35.1"<br/>E 19° 09' 08.8"</p> | <p><b>Nieuwoudtville Mosaic</b><br/><br/><b>Nieuwoudtville Shale Renosterveld</b></p> | <p>This location is at the R 27-8 3.4E marker. The road reserve is in poor condition. The vegetation consists mainly of dry grass and weedy species. No Nieuwoudtville Shale Renosterveld is present and the adjacent private land has also been cleared of natural vegetation.</p> |   |
| <p><b>CN28</b><br/>S 31° 22' 16.0"<br/>E 19° 08' 21.4"</p> | <p><b>Nieuwoudtville Mosaic</b><br/><br/><b>Nieuwoudtville Shale Renosterveld</b></p> | <p>Near road marker R27-8 2.0 E. The road reserve is in poor condition. The verge is mowed and is populated by <i>Eragrostis curvula</i>. Other species recorded are <i>Galenia africana</i>, <i>Gomphocarpus fruticosus</i> and <i>Erodium moschatum</i>.</p>                      |  |

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| <p><b>CN29</b> S 31° 22'<br/>09.8" E 19° 07'<br/>43.7"</p> | <p><b>Nieuwoudtville Mosaic</b></p> <p><b>Nieuwoudtville Shale</b></p> <p><b>Renosterveld</b></p> | <p>This location is close to the R 27-8 1.0E marker at the entrance to the Nieuwoudtville Landfill. The road reserve is highly transformed and disturbed. The vegetation is dominated by grass and exotic static or sea lavender (<i>Limonium sinuatum</i>) that has no doubt escaped from the nearby town. Other species recorded here include <i>Gomphocarpus fruticosus</i>, <i>Eragrostis curvula</i>, <i>Avena fatua</i> and <i>Salsola kali</i>.</p> |   |
| <p><b>CN30</b><br/>S 31° 22' 10.6"<br/>E 19° 07' 05.1"</p> | <p><b>Nieuwoudtville Mosaic</b></p> <p><b>Nieuwoudtville Shale</b></p> <p><b>Renosterveld</b></p> | <p>This location is on the outskirts of Nieuwoudtville. Stands of <i>Albuca canadensis</i> are found on both sides of the road. According to Vlok &amp; Schutte-Vlok (2010) presence of this species in abundance indicates intense disturbance and this is clearly the case here. The road reserve is dominated by grass and other weedy species contribute to the vegetation matrix.</p>   |  |